

Aquatic Community Classification System for Missouri

by William L. Pflieger

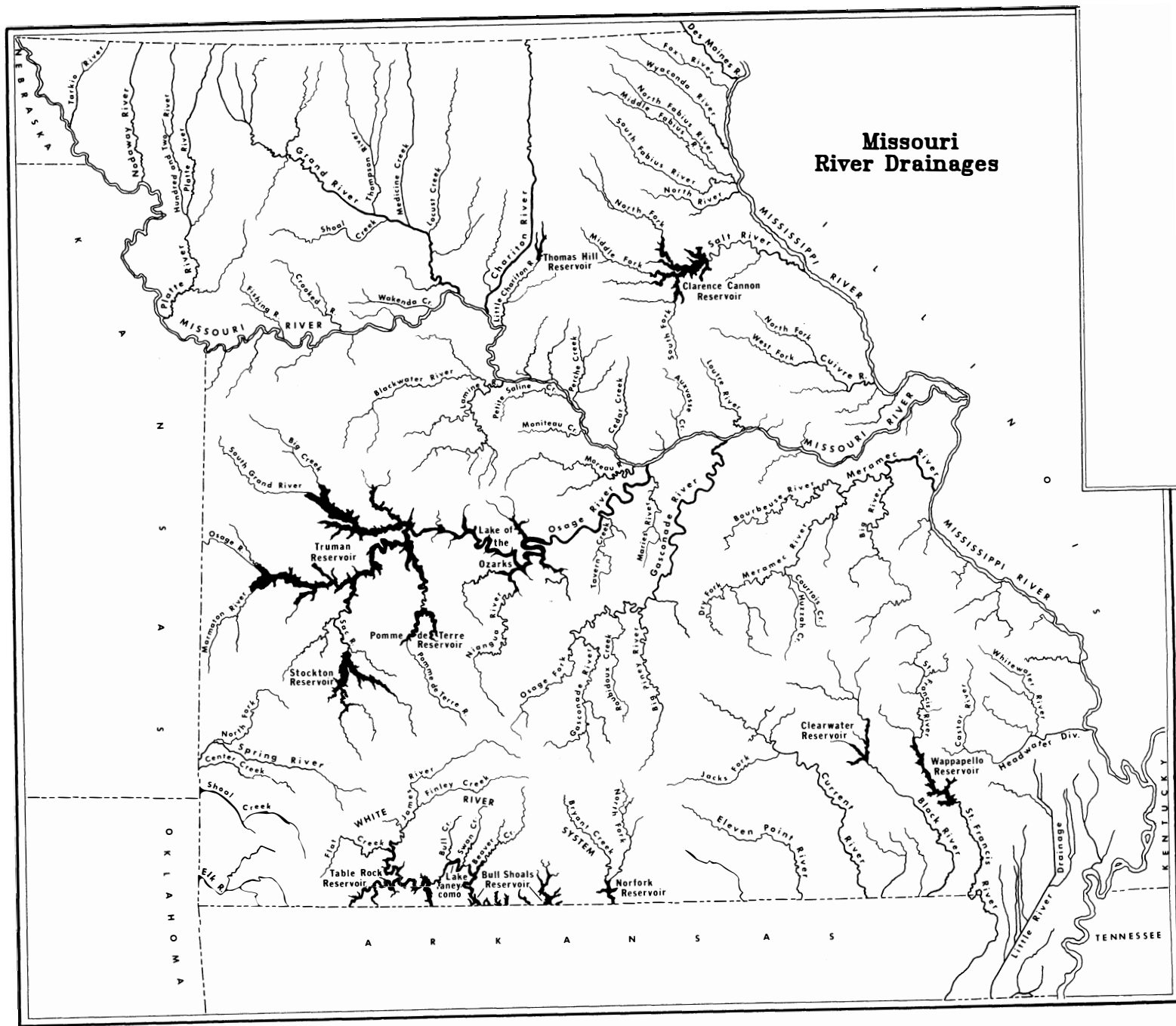
Aquatic Series No. 19

Missouri Department of Conservation
Jefferson City, Missouri
May, 1989

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**AQUATIC
SERIES NO. 19**

Missouri River Drainages



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Photos by William L. Pflieger, James E. Rathert,
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Introduction

Because of its physiographic diversity and central location in the Mississippi Valley, Missouri supports a rich and varied aquatic biota. The native fish fauna includes at least 211 species and subspecies, approximately two-thirds of those known for the entire Mississippi Valley. Other groups of aquatic organisms are similarly diverse.

The following classification is based primarily on fishes because their distribution is better known than that of other aquatic organisms. Also, they exhibit patterns of distribution that are strongly correlated with environmental factors such as bedrock geology, topographic relief, and stream size that are thought to be important in controlling the distribution of aquatic organisms generally.

The utility of fish collections for defining broad fish faunal regions has been demonstrated (Pflieger 1971). That these faunal regions also comprise broad aquatic habitat regions is suggested by the correspondence between these regions and variations in certain physical features of streams, such as turbidity, substrate, base flow and gradient. Development of this classification was facilitated by development of a computerized file of fish faunal information that permitted a quantitative analysis of the relationships between fish distribution patterns and physical features of their environment. This data base and the analytical procedures are described elsewhere (Pflieger *et al.*, 1981a, 1981b).

I hope this classification will have wide use in the management and protection of Missouri's aquatic resources. It is a further elaboration of a classification proposed by Pflieger and Funk (1974) for the selection and designation of aquatic areas for inclusion in the Missouri Natural Areas System. A companion classification of terrestrial natural communities has been published (Nelson 1985), and a classification of geologic features has been adopted by the Missouri Natural Areas Committee and will be published soon (Hebrank, 1983).

The patterns of distribution and relative abundance that are the basis for this classification result from the interaction of numerous factors, including contemporary environmental conditions, barriers to dispersal, and events that occurred during the developmental history of the biota. Three parameters that exhibit strong correlation with distribution patterns provide the framework for this classification. These parameters are: (1) physiography, (2) drainage relationships and (3) stream size.

In this classification, Missouri is divided into four principal faunal regions (Fig. 1), of which three (Ozark, Lowland and Prairie) correspond closely with major physiographic subdivisions. A fourth principal region (Big River) is recognized for Missouri's largest rivers, the Missouri and Mississippi. In three of these regions (Ozark, Prairie and Big River), further subdivisions are defined that correspond to major drainage areas. Subdivisions of the Lowland Region are not thus defined because distribution patterns in the lowlands are not strongly correlated with drainage relationships.

Within the Ozark and Prairie regions the lowest levels of the classification (Headwater, Creek, Small River and Large River) reflect variations in stream size. Drainage area is perhaps a better indicator of stream size, but stream order and miles-to-headwater are more readily determined, and provide criteria for defining the stream types listed above. In the stream order system, ultimate headwater streams are designated as order 1. Two order 1 streams join to form an order 2 stream, and the order continues to increase by one each time two streams of the same order join. Miles-to-headwater is the distance along the stream channel, from any given location upstream to the drainage divide of the longest ultimate headwater tributary. Topographic maps (7.5-minute or 15-minute) are used to determine stream order and miles-to-headwater.

Although the organization of this classification is consistent with patterns of fish distribution and abundance, the distinctions made between communities is quite subjective. Striking differences are evident in the kinds of fishes found in different areas or even in different sections of the same stream, but transitions between these distinctive communities are seldom abrupt, and therefore the delimitation of boundaries is arbitrary. In developing the classification, communities were first defined in terms of their faunas. Correlations were then made with physical features (*e.g.* drainage divides and stream order) and the physical features were used for convenience in defining the aquatic community boundaries. The advantage of this approach is that aquatic communities can be classified and their faunas predicted solely by their location, using criteria that can be determined on maps.

The community descriptions follow a uniform arrangement to include a small map and discussion of community occurrence in Missouri, a description of physical features and biota, and community examples. In discussing the biota, primary emphasis is on fishes, but other characteristic animals and plants are also listed. Common names are used throughout the text. The common and scientific names are associated in Appendix I to answer questions that may arise concerning the scientific name of an animal or plant. Technical terms are kept to a minimum, and those essential for clarity or conciseness are listed in Appendix II. For a description of the terms "longitudinal zonation" and "Margalef Diversity Index" please refer to Appendix II. If the reader would like more complete information on the fishes and physical features of a particular community, these are provided by the tables in a Supplement. This Supplement is available from the author by request. The tables are arranged in the order of the community discussions in the text. The principal streams and physiographic regions of Missouri are designated on maps located on the inside covers of this publication.

Primary emphasis in this classification is on communities associated with flowing waters, because virtually all native Missouri fishes are associated with streams and their overflow waters. All of the aquatic communities recognized in

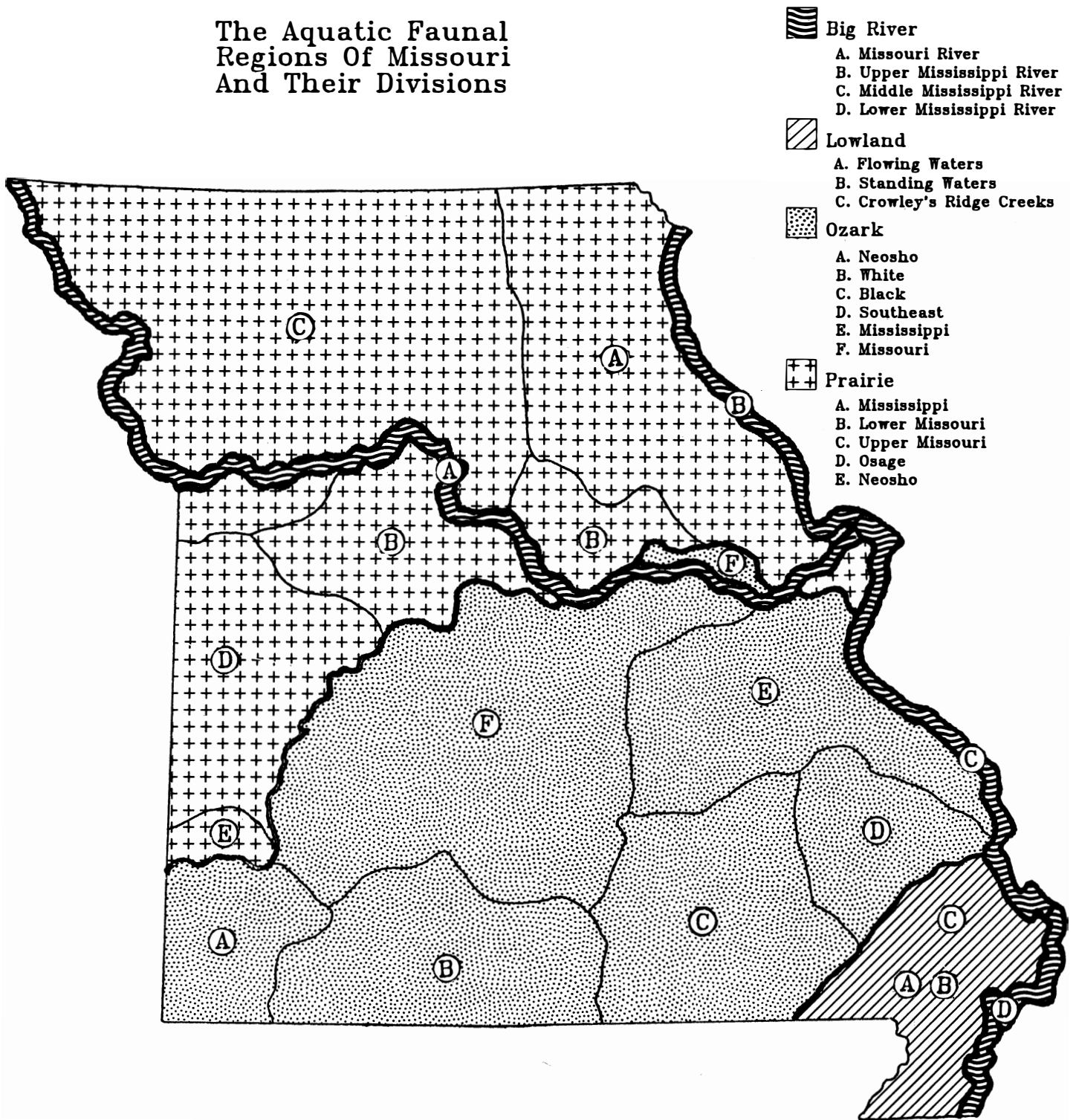
this classification have been impacted to varying degrees by man's activities, but some now exist only in drastically disturbed habitats. However, communities in some of the most disturbed habitats support distinctive assemblages of fishes, often including rare or endangered species found nowhere else. These communities are included for completeness and to make the classification useful in protecting their distinctive faunas. On the other hand, aquatic communities found in the numerous manmade impoundments that dot the Missouri landscape have been omitted. Although these communities are an important resource, they are often dominated by introduced fishes, and their classification was beyond the scope of this investigation.

This aquatic community classification was developed as part of a research project entitled "The Stream Resources of Missouri" (Dingell-Johnson Project F-1-R, Study S-20). Many of the fish collections used in its development actually predate the project, and I have acknowledged the contributions of those who contributed to the collection of this data elsewhere (Pflieger 1975). Additional collections were made in developing the classification, primarily to determine

changes in fish communities along the lengths of various streams. Collections that were useful in developing the classification were also obtained in conjunction with other projects (Pflieger, 1978 and 1984, Pflieger and Grace, 1987).

Of the numerous individuals who assisted me in collecting and compiling this data, I am particularly indebted to Timothy B. Grace. For help in developing the computer files and computer programs for accessing and analyzing the data I am indebted to Pamela S. Haverland and M. Anthony Schene, Jr. Alan C. Buchanan and Tom R. Johnson advised me concerning freshwater mussels, amphibians and reptiles characteristic of the various communities. Other individuals that reviewed an early draft of the classification and offered suggestions include John F. Belshe, Frank B. Cross, David Foster, H.E. McReynolds, Paul W. Nelson, Linden Trial, and Jerry D. Vineyard. I appreciate the skill and patience of T.J. Aholt and Ann Anderson in transcribing various drafts of the manuscript. James P. Fry, Joe G. Dillard, and James R. Whitley provided administrative support and encouragement for this project from its inception.

The Aquatic Faunal Regions Of Missouri And Their Divisions





Mississippi River, Ralls County (Big River Region)

I. Big River Faunal Region

Distribution:

This faunal region includes the Missouri River and Mississippi River mainstems, and adjacent standing waters that are subject to frequent flooding by these rivers.

Physical Features:

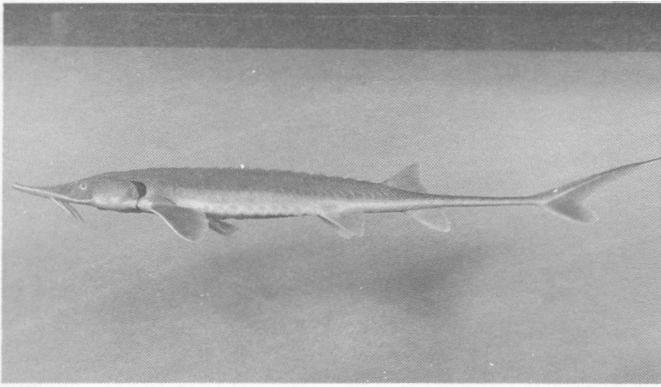
These streams occupy flood plains varying in width from two to 10 miles, except in southeastern Missouri where the flood plain blends almost imperceptibly into the adjacent Southeastern Lowlands of the Missouri "bootheel." River channels are developed in deep deposits of gravel, sand, and silt, and before alteration by man they were frequently braided, with numerous islands, side channels and backwaters. The flow regimen is characterized by continuous strong flow and one or more periods of sustained flooding each year. Gradients are less than one foot per mile. Silt, sand and gravel are the predominant substrates. Standing waters, varying from large, permanent oxbow lakes to small, seasonal sloughs are common on the adjacent flood plains.

Biota:

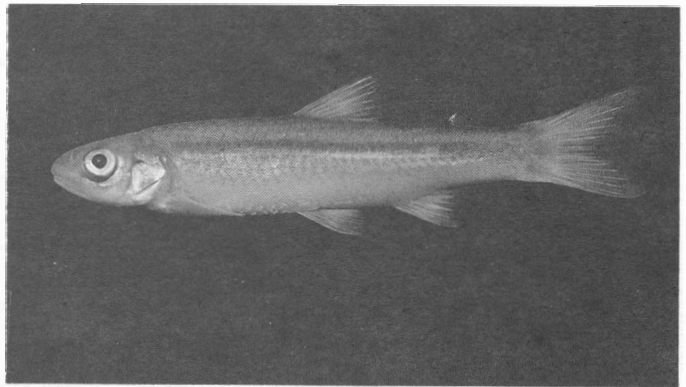
Twelve fishes (silver lamprey, lake sturgeon, pallid sturgeon, alligator gar, threadfin shad, burbot, yellow bass, striped mullet, spottail shiner, silverband shiner, sturgeon chub, and sicklefin chub) are virtually confined in their natural distribution to the big rivers and their associated overflow waters. Common fishes that are especially characteristic of the Big River Faunal Region include: chestnut lamprey, shovelnose sturgeon, skipjack herring, goldeye, blue sucker, blue catfish, white bass, sauger, freshwater drum, flathead chub, silver chub, emerald shiner, river shiner, channel mimic shiner, and speckled chub.

The alligator snapping turtle and Mississippi map turtle are characteristic of those sections of the Missouri and Mississippi rivers within their respective ranges. Other common turtles in the Big River Faunal Region include the common snapping turtle and the spiny softshell turtle (two subspecies).

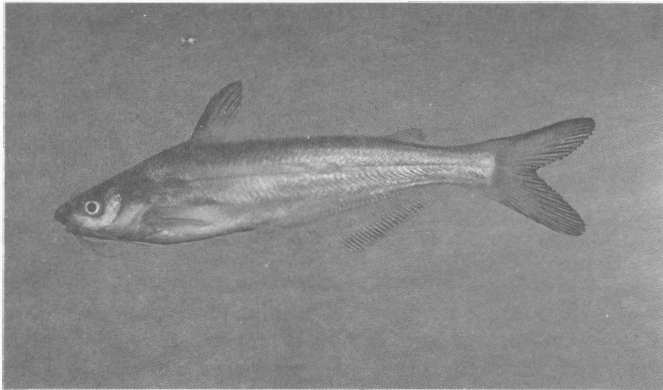
Animals of the Big River Faunal Region



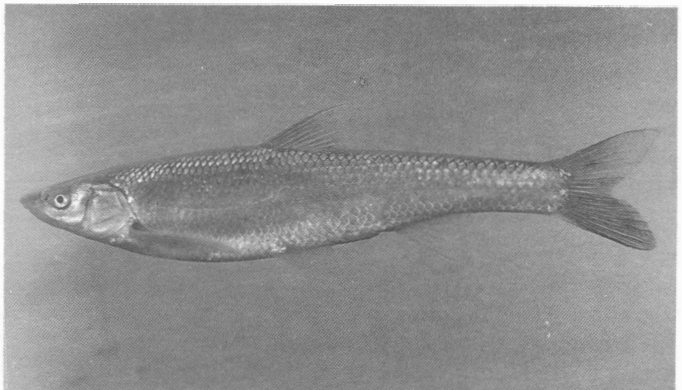
Shovelnose sturgeon



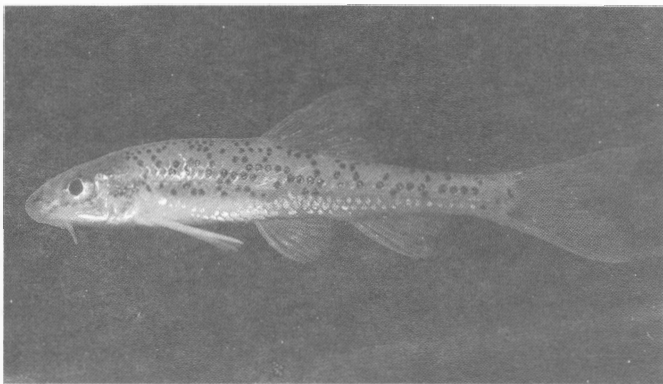
River shiner



Blue catfish



Flathead chub



Speckled chub



Alligator snapping turtle



Missouri River, Boone County (Entire length)

I. A. Missouri River

Distribution:

This community occurs in the main stream of the Missouri River along its entire length within the state.

Physical Features:

Historically, the Missouri River was one of the most turbid large streams on the North American Continent, and occupied a wide, braided channel that was in a constant state of change. This instability resulted from the rapid current, substantial bedload of fine sediments, and wide fluctuation in volume of flow. Through the construction of an extensive system of rock dikes and revetments, the river is now confined to a single, narrow channel of rather uniform width, with swift current, and few quiet backwaters. The construction of six large main stream reservoirs on the river north of the state of Missouri have modified the natural flow regimen and measurably reduced the turbidity all the way to the river mouth. The average gradient of the Missouri section of the river is 0.90 feet per mile, a relatively high gradient for such a large stream. The substrate consists principally of silt and sand.

Biota:

The fish fauna of the Missouri River has been drastically altered by the habitat changes outlined above. Unless otherwise indicated, the following remarks apply to the fauna as it existed in the 1940s when faunal composition more nearly approached its natural condition. Typical species were: Large—shovelnose sturgeon, shortnose gar, gizzard shad, goldeye, common carp, river carpsucker, blue sucker, bigmouth buffalo, blue catfish, channel catfish, flathead cat-

fish, and freshwater drum; Nektonic—western silvery minnow, plains minnow, flathead chub, silver chub, and red shiner; Benthic—speckled chub, sturgeon chub, and sicklefin chub. The pallid sturgeon was uncommon, but was especially characteristic. Today, the pallid sturgeon and flathead chub are on the verge of extirpation. The skipjack herring, grass carp, bighead carp, silver carp, white bass, and rainbow smelt are now a part of the fauna. Sunfishes (*Centrarchidae*) and shiners (*Notropis*) are much more prevalent.





Mississippi River, Lincoln County (Upper Mississippi River)

I. B. Upper Mississippi River

Distribution:

The main channel of the Mississippi River from its junction with the Missouri River upstream to the Iowa state border.

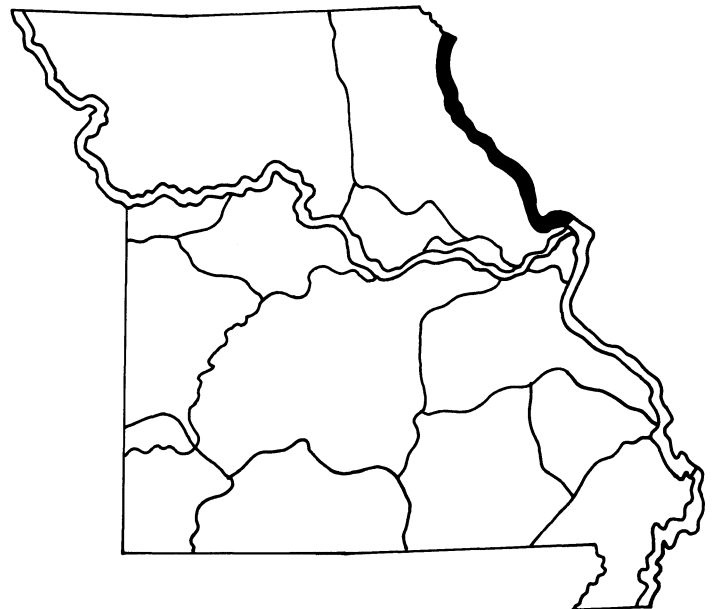
Physical Features:

Historically, the Upper Mississippi River consisted of deep pools separated by shallow bars and rapids. It was clearer than the Missouri, and the substrate included a greater proportion of rocks and gravel. The upper Mississippi has been converted into a series of river lakes through the construction of a series of lock and dams, six of which are in the Missouri section of the river. Areas of riverlike habitat still remain below the locks and dams, and the following remarks concerning the biota apply principally to this habitat. The stream gradient is less than that of the Missouri River, averaging 0.49 feet per mile.

Biota:

In this division the following fishes are more common than in other river divisions: Large—gizzard shad, white bass, orangespotted sunfish, bluegill, smallmouth bass, largemouth bass, white crappie, and black crappie. Nektonic—ghost shiner, bigmouth shiner, and bullhead minnow; Benthic—stonecat, freckled madtom, western sand darter, slenderhead darter, and river darter. The emerald shiner and river shiner are the most abundant nektonic fishes in all Mississippi River divisions. The northern logperch is restricted to this river division or occurs elsewhere only as intergrades with the Ozark logperch. In recent years, the threadfin shad and grass carp have invaded the Upper Mis-

issippi Division, and the ghost shiner and western sand darter have undergone a drastic decline. Other benthic fishes may also have declined.





Mississippi River, Cape Girardeau County (Middle Mississippi River)

I. C. Middle Mississippi

Distribution:

The main channel of the Mississippi River between the mouth of the Ohio River and the mouth of the Missouri River.

Physical Features:

This Mississippi River Division is similar in character to the Missouri River, but on a larger scale. Channelization has been accomplished here as in the Missouri River by the construction of rock wing dikes and revetments. The turbidity is high, but is less than that of the Missouri River. The current is swift, with few quiet backwaters. Silt, sand, and small gravel are the principal bottom types, but coarse rock occurs in some areas. Bedrock outcrops occur at Thebes Gap downstream from Cape Girardeau. The stream gradient is higher than in the Upper Mississippi but lower than in the Missouri River, averaging 0.56 feet per mile.

Biota:

Historically, the fish fauna of the Middle Mississippi Division was characterized by a mixture of species typical of the Missouri and Upper Mississippi divisions. The pallid sturgeon, western silvery minnow, plains minnow, flathead chub, sturgeon chub, and sicklefin chub were shared with the Missouri River, but these species are now on the verge of extirpation from the Middle Mississippi Division. Shiners (emerald shiner, river shiner, red shiner, silverband shiner, and channel mimic shiner) were common in the 1940s, but all show trends towards increased abundance. Benthic fishes (speckled chub, stonecat, and river darter) are becoming increasingly uncommon.





Mississippi River, Pemiscot County (Lower Mississippi River)

I. D. Lower Mississippi River

Distribution:

This community occurs in the main stream of the Mississippi River from the mouth of the Ohio River to the Arkansas state line.

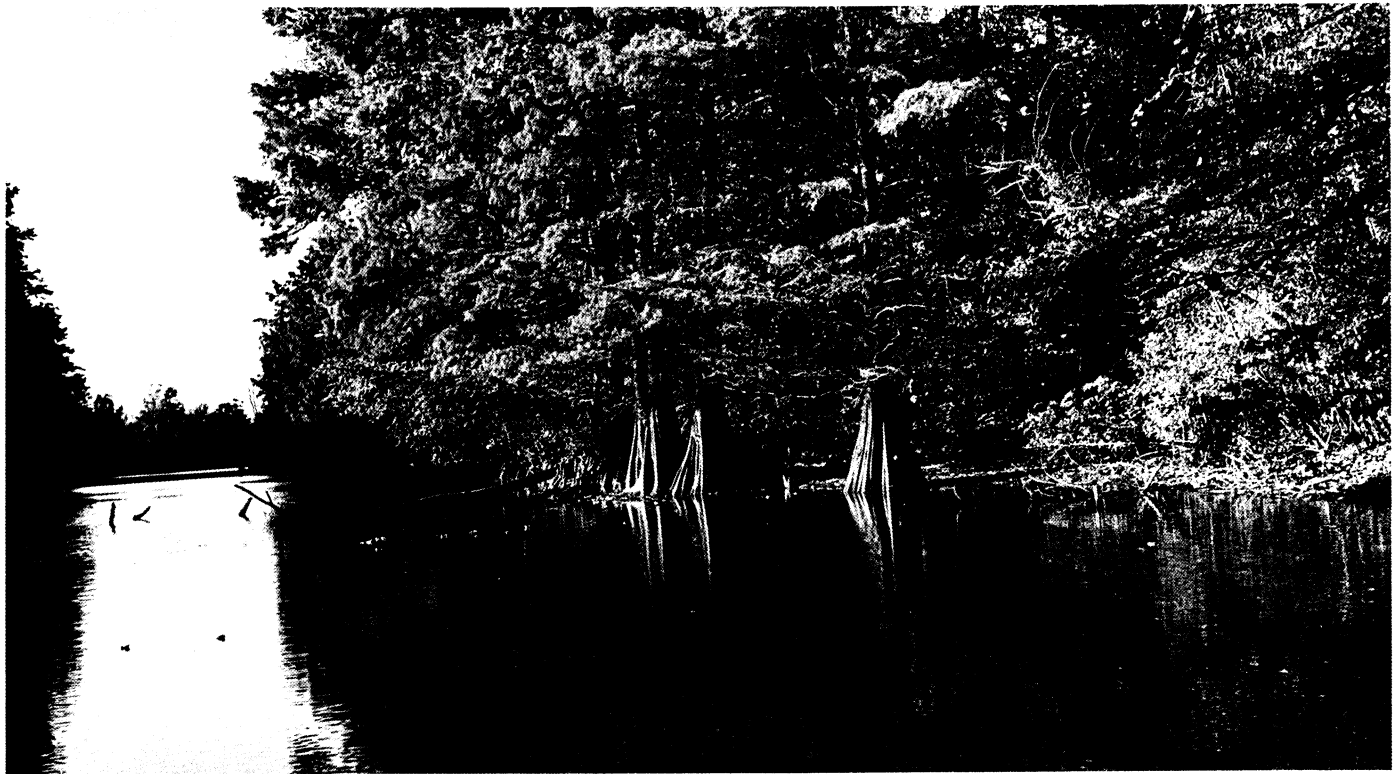
Physical Features:

The flow of the Mississippi River more than doubles at the mouth of the Ohio River, and the clear waters from the Ohio markedly reduce turbidity. The channel is wider and deeper, with more islands and backwaters. Sand and fine gravel are the principal substrate types. Bottom material larger than coarse gravel is absent. The stream gradient is lower than in other river divisions, averaging 0.39 feet per mile. The division seems to have been less affected by navigation works and pollution than other Big River divisions.

Biota:

Herrings comprise a greater proportion of the fish fauna than in other Big River divisions, and the skipjack herring is particularly abundant. The threadfin shad was formerly restricted to this division. The white bass and yellow bass are more common than in the Middle Mississippi Division. The striped mullet has been recorded in Missouri only from this river division. The brook silverside and inland silverside are much more common than in other river divisions, and the latter species does not occur naturally elsewhere in Missouri. The river shiner, silverband shiner and channel mimic shiner also achieve their greatest abundance here. The speckled chub is the only common benthic species. Madtoms and darters occur only as strays.





Wolf Bayou, Pemiscot County (Overflow Waters)

I. E. Overflow Waters

Distribution:

This community occurs in oxbow lakes, sloughs, "blue holes," and other standing waters that have floodwater connections to the Missouri and Mississippi rivers.

Physical Features:

The habitat varies markedly, depending on Big River Division, frequency of floodwater connections with the river, and amount of current flowing through in time of flood. Some Overflow Waters are shallow and subject to fish kills resulting from high temperature, low oxygen, and drying. Others are deep as a result of scouring, and maintain conditions suitable for survival of fish throughout the year.

Biota:

The fish communities occurring in these habitats vary with the physical features reported above. The species present are generally a subset of those found in the adjacent river, but also include species from the faunal region that borders the river. The species composition is also affected by the type of floodwater connection, and may change over time after the river recedes, due to differential survival of the species present when the Overflow becomes isolated. The most abundant species in Overflow Waters are those typical of backwaters in the river.

Common fishes in Overflow Waters of the Big River Region include: Large—paddlefish, shortnose gar, gizzard shad, carp, bigmouth buffalo, black bullhead, largemouth bass and white crappie; Nektonic—golden shiner, emerald shiner, red shiner, mosquitofish, and brook silverside; Benthic—none common.

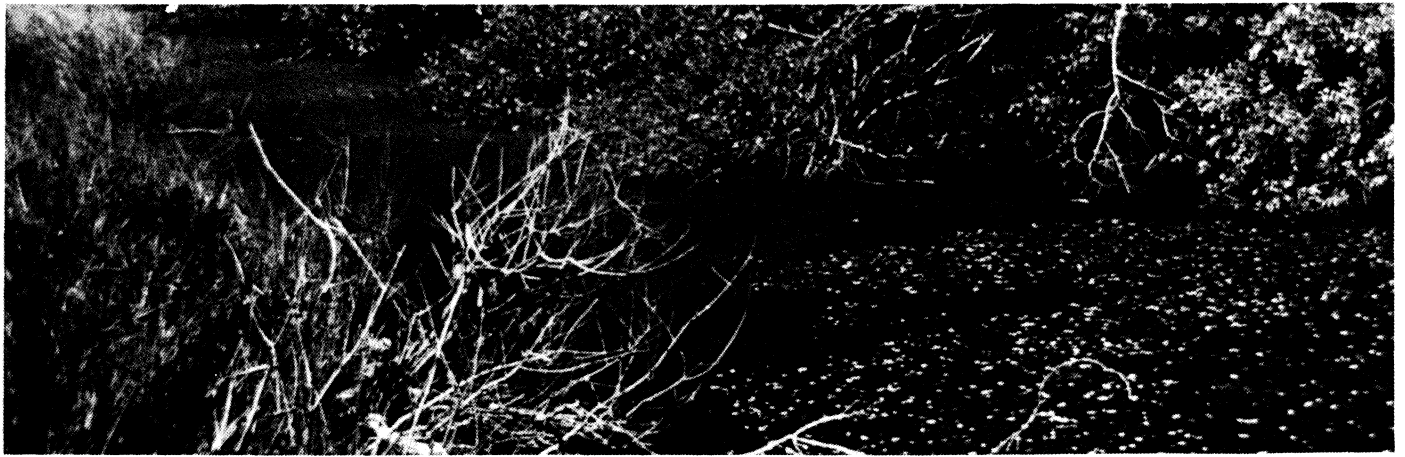
Two amphibians, the plains spadefoot and Great Plains toad, breed in Missouri only in temporary pools along the flood plain of the Missouri River. Typical reptiles of this community type are the stinkpot, western painted turtle, diamondback water snake, and Graham's crayfish snake.

Crayfish are often abundant in shallow, temporary sloughs. Typical species are the papershell crayfish and white river crayfish.

Examples:

Wolf Bayou, Pemiscot County; Brickhouse Slough, St. Charles County; Little Bean Marsh, Platt County.





Roadside Slough, New Madrid County (Lowland Region)

II. Lowland Faunal Region

Distribution:

This faunal region is coextensive with the South-eastern Lowlands Physiographic Region of the Missouri "bootheel." It is set off from the Ozark Region to the north and west by an abrupt change in elevation of 50 to 250 feet, from the level of the lowlands to the level of the adjacent uplands.

Physical Features:

The Lowland Region is a broad alluvial plain, with a surface relief that is generally less than 10 feet. Its only prominent topographic feature is Crowley's Ridge, which rises 50 to 150 feet above the general level of the plain. Bedrock is exposed at some places in Crowley's Ridge, but elsewhere is covered by deep deposits of alluvium and loess. Before settlement, extensive swamps occurred in the lowlands, and several Ozark streams entered the lowlands from the north. The drainage of Little River which formerly received the flow of the Castor and Whitewater rivers has been disrupted by the construction of a diversion canal, and a complex network of ditches now drains most areas formerly covered by swamp.

Approximately 1,200 miles of ditches and the few remaining natural streams and swamps comprise the principal habitat for aquatic life in the lowlands. The streams and ditches have well-sustained base flows because the alluvial deposits are excellent aquifers. Gradients are generally less than one foot per mile. Some of the ditches are quite clear, while others have a persistent turbidity. The substrate in the swifter areas of ditches and streams is mostly sand and some gravel, while that in quiet areas is usually silt. The swamps and other standing-water habitats also vary in turbidity, and are subject to wide seasonal fluctuations in area and depth. Silt and organic debris are typical substrates in standing-water habitats.

Biota:

Twenty-three species of fishes (spotted gar, brown bull-head, cypress minnow, ironcolor shiner, ribbon shiner, tail-light shiner, Sabine shiner, weed shiner, blacktail shiner, pugnose minnow, lake chubsucker, spring cavefish, pirate

perch, starhead topminnow, flier, banded pygmy sunfish, bantam sunfish, swamp darter, harlequin darter, goldstripe darter, cypress darter, saddleback darter, and dusky darter) are restricted in Missouri to the lowlands or occur elsewhere only rarely. The golden topminnow formerly was restricted to this region but has been extirpated from Missouri. Other characteristic fishes include spotted sunfish, warmouth, bull-head minnow, mosquitofish, tadpole madtom, crystal darter, mud darter, bluntnose darter, and slough darter.

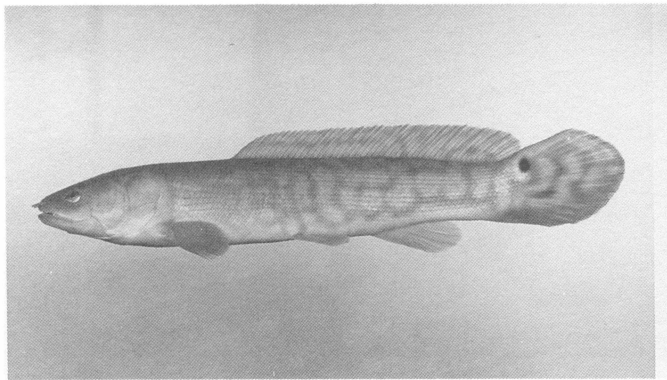
Amphibians and reptiles that are largely restricted to the Lowland Faunal Region include the mole salamander, three-toed amphiuma, green tree frog, Illinois chorus frog, upland chorus frog, bronze frog, Mississippi mud turtle, southern painted turtle, western chicken turtle, western mud snake, green water snake, and broad-banded water snake.

Several species of crayfish including the dwarf crayfish (two species) eastern digging crayfish, shield crayfish, shrimp crayfish, gray-speckled crayfish, red swamp crayfish, and vernal crayfish, are similarly restricted. The mussel *Plecomerus dombeyana* occurs only in this region.

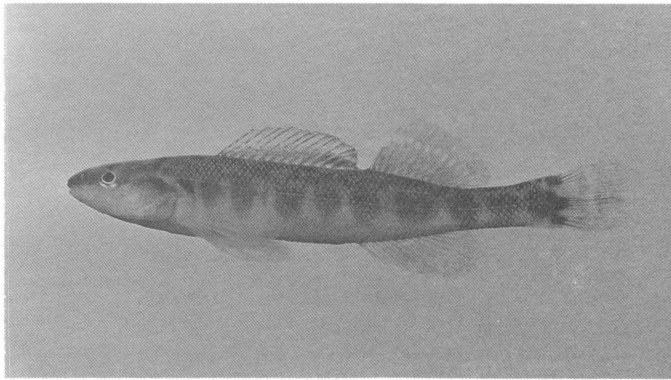
Bald cypress and swamp tupelo are largely restricted in their natural distribution to the lowlands.



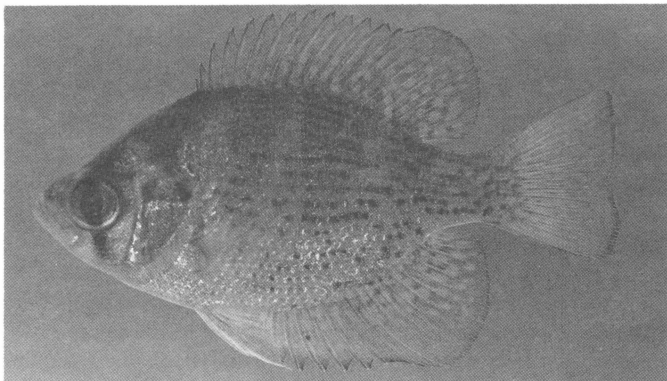
Animals of the Lowland Faunal Region



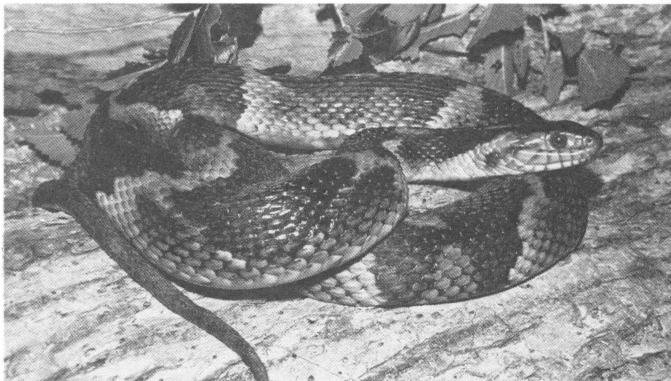
Bowfin



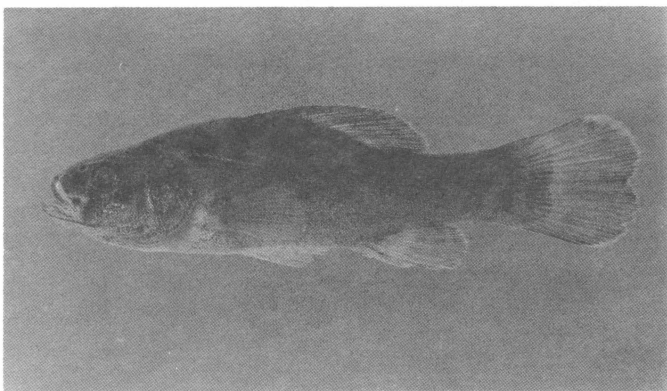
Dusky darter



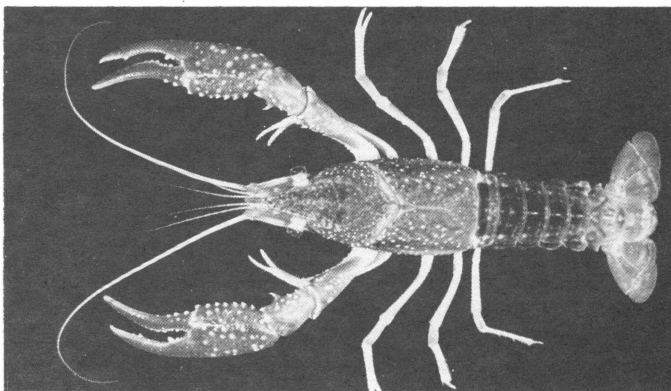
Flier



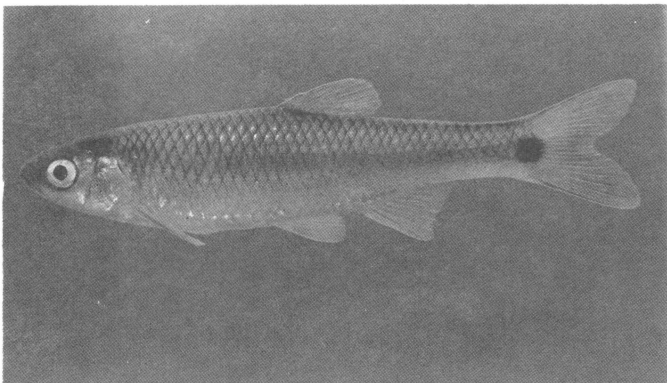
Broad-banded water snake



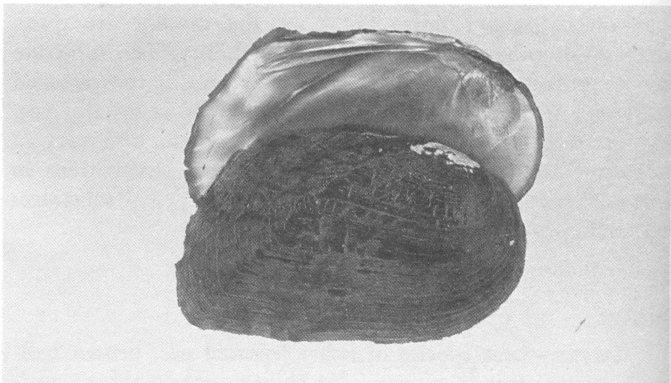
Pirate Perch



Red swamp crayfish



Blacktail shiner



Bankclimber mussel



Honey Cypress Ditch, Dunklin County (Clear, Heavily Vegetated Ditches)

II. A. Flowing Waters

This division includes the communities of all flowing waters in the Lowland Faunal Region, except for Crowley's Ridge Creeks. Included are the approximately 1,200 miles of drainage ditches and the remaining natural stream channels. Gradients average about one foot/mile. Substrates are silt, sand, and small gravel. The larger rivers and ditches generally have considerable current, while some of the smaller ones are without noticeable current. Flow is generally permanent, because the unconsolidated sands and gravels underlying the lowlands are excellent aquifers.

The fish communities are generally more diverse and rich in species than other Lowland communities. Common fishes include: Large—gizzard shad, longear sunfish, spotted sunfish, carp, orangespotted sunfish, bluegill, spotted bass, channel catfish, largemouth bass, and shadow bass; Nektonic—blacktail shiner, bullhead minnow, mosquitofish, weed shiner, ribbon shiner, blackspotted topminnow, bluntnose minnow, emerald shiner, eastern redbfin shiner, and black-stripe topminnow. Benthic—cypress darter, slough darter, bluntnose darter, tadpole madtom, dusky darter, blackside darter, and scaly sand darter.

Characteristic amphibians and reptiles include the western lesser siren, stinkpot, Missouri River cooter, red-eared slider, yellowbelly watersnake, diamondback water snake, and western cottonmouth. The grey-speckled crayfish is largely restricted to flowing waters in the Lowlands.

Submergent aquatic vegetation is abundant in many of the smaller, clearer ditches. Common species include water milfoil, elodea, and mud plantain. Water willow often forms extensive beds along the margins of the larger ditches and streams.

Three community types are recognized in Flowing Waters.

II. A. 1. Clear, Heavily Vegetated Ditches.

Distribution:

This community type occurs throughout the Lowland Faunal Region.

Physical Features:

All of the localities having this community type were in small to medium-sized drainage ditches. Most were quite clear and many were without noticeable current.

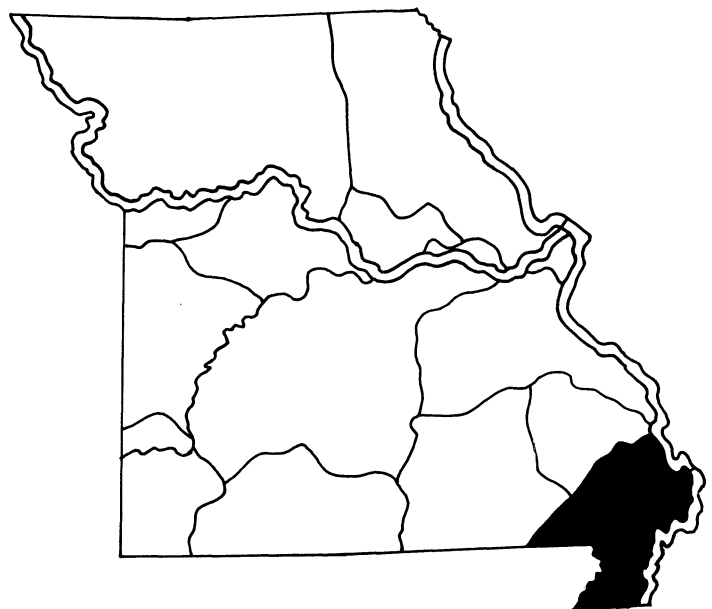
Biota:

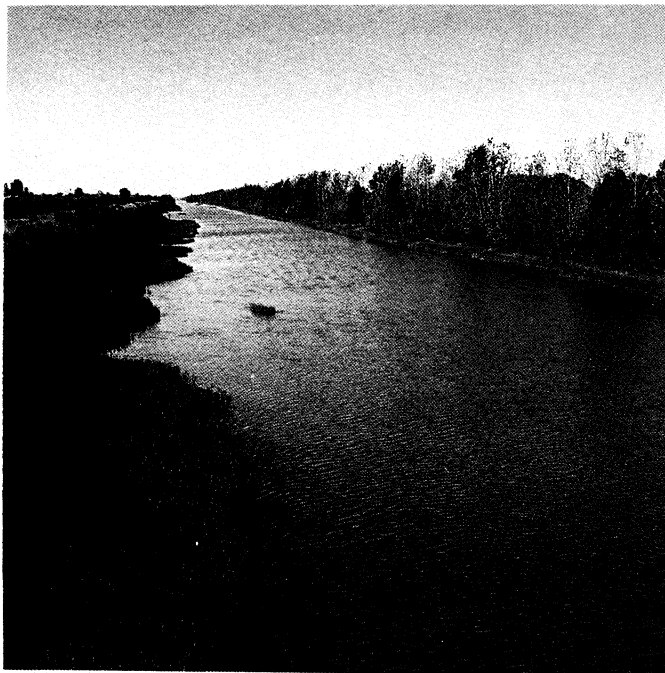
Characteristic fishes include grass pickerel, yellow bullhead, ironcolor shiner, lake chubsucker, banded pygmy sunfish, and slough darter. The largemouth bass is generally more abundant than the spotted bass, and the spotted sunfish achieves its greatest abundance in this community. Sand darters (*Ammocrypta*) are absent. The bullhead minnow occurs only rarely and the blacktail shiner is much less common than in other flowing waters.

Submergent and floating aquatic plants are abundant. Elodea and water primrose are typical species.

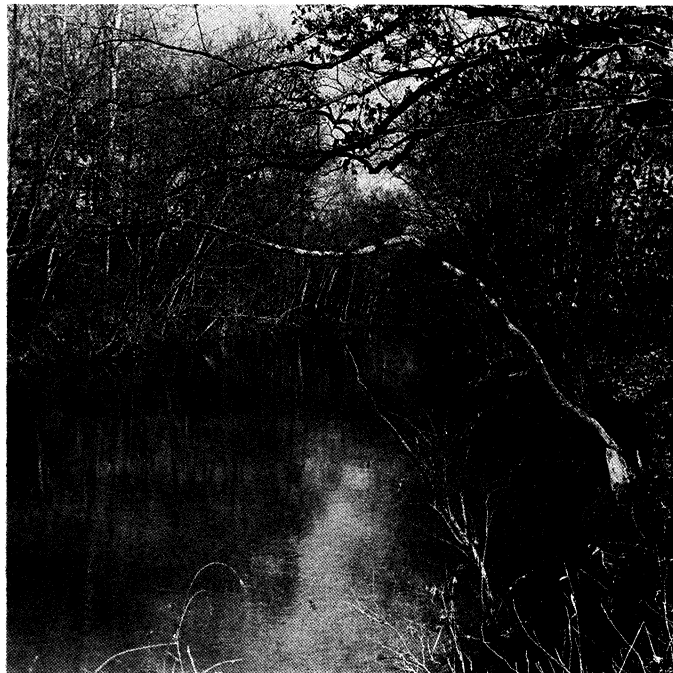
Community Examples:

Honey Cypress Ditch, Dunklin County; Ditch No. 1, New Madrid County; Maple Slough, Mississippi County.





Ditch Number 1, Pemiscot County (Turbid, Sparsely Vegetated Ditches)



Little Black River, Ripley County (Natural Lowland Streams and Larger Ditches)

II. A. 2. Turbid, Sparsely Vegetated Ditches.

Distribution:

This community type occurs throughout the Lowland Faunal Region.

Physical Features:

All of the localities having this community type were in drainage ditches, most of which were medium-sized to large. Turbidity is often moderate to high, and cover is often restricted to undercut banks.

Biota:

Characteristic fishes include highfin carpsucker, shadow bass, green sunfish, northeastern mimic shiner, speckled chub, scaly sand darter, speckled darter, saddleback darter, and river darter. The spotted bass is usually the most abundant species of blackbass, and the longear sunfish generally replaces the spotted sunfish as the most common *Lepomis*. The blacktail shiner and bullhead minnow are often the dominant Nektonic fishes. The pallid shiner was formerly prevalent but is now extirpated.

Submergent aquatic vegetation is often sparse. Water willow frequently lines the shore or forms extensive beds in the channel.

Community Examples:

West Ditch, Dunklin County; Huffstetter Lateral, Stoddard County; Ditch No. 7, New Madrid County.

II. A. 3. Natural Lowland Streams and Larger Ditches.

Distribution:

This community type occurs throughout the Lowland Faunal Region.

Physical Features:

This community type occurs in medium to large lowland streams and the larger drainage ditches. Turbidity is usually moderate to high. Substrates are mostly sand, small gravel, and silt. Stream gradients are usually one foot/mile or less.

Biota:

Diversity and species richness are generally higher than in other flowing waters. Characteristic fishes include the shortnose gar, black buffalo, flathead catfish, orangespotted sunfish, white crappie, Mississippi silvery minnow, Cypress minnow, pugnose minnow, and harlequin darter. The Sabine shiner and bluntnose darter achieve their greatest abundance in this community type. The blacktail shiner and bullhead minnow are usually the dominant Nektonic fishes. The spotted sunfish and weed shiner are generally uncommon.

Community Examples:

Castor River (old channel), Stoddard County; St. Francis River, Dunklin County; Little Black River, Ripley County.



Allred Lake, Butler County (Standing Waters)

II. B. Standing Waters

Distribution:

This community type occurs throughout the Lowland Faunal Region, in swamps, stream cut-offs and scour holes, and borrow pits. Formerly, this was the most prevalent community type in the region, but most standing waters have been ditched and drained.

Physical Features:

This habitat consists of natural or man-made depressions that intersect the water table. Many are subject to frequent flooding by lowland streams. Typically, water levels fluctuate drastically on a seasonal basis. Current is absent except during floods. The water is warm and usually clear, often stained by organic acids. The substrate consists of silt, often overlain by varying quantities of leaves, sticks, and other organic debris.

Biota:

The brown bullhead, bantam sunfish, and swamp darter have been recorded in Missouri only from this habitat. The bowfin, spotted gar, pugnose minnow, starhead topminnow, pirate perch, flier, banded pygmy sunfish and mud darter are other characteristic species. The large-fish fauna is usually dominated by sunfish, including the bluegill, warmouth, white crappie, green sunfish, and largemouth bass. Gizzard shad are often abundant. The mosquitofish, brook silverside, blackspotted topminnow, banded pygmy sunfish, pugnose minnow, and golden shiner are among the common nektonic fishes. The cypress darter, bluntnose darter, and slough darter are the most abundant benthic fishes.

Typical amphibians and reptiles include the three-toad amphiuma, mole salamander, bronze frog, green tree frog, southern painted turtle, Mississippi mud turtle, western mud snake, and yellowbelly water snake.

The dwarf crayfish (2 species) and vernal crayfish are largely restricted to this community. The red swamp crayfish is usually the most abundant *Procambarus*.

Submergent plants are abundant in the open waters of the clearer standing-water habitats. Common species include water milfoil, bladderwort, and water shield. Emergent vegetation is also common in natural habitats. Typical species are American lotus, button bush, bald cypress, and swamp tupelo.

Community Examples:

Mingo Swamp, Wayne County; Allred Lake, Butler County; Otter Slough, Stoddard County.





Holly Ridge Creek, Stoddard County (Crowley's Ridge Creeks)

II. C. Crowley's Ridge Creeks

Distribution:

This community type occurs in small streams draining Crowley's Ridge, and also in small streams along the boundary between the Ozark and Lowland faunal regions.

Physical Features:

Crowley's Ridge is the most prominent topographic feature in the Lowlands Faunal Region. Elevations, local relief, and gradients are higher than in other community divisions of the Lowlands. Some bedrock exposures occur, but the uplands are mostly mantled with clays, sands, and gravels. The streams are all quite small, with substrates of sand and small gravel. Seep springs are common. Small streams that drain the margin of the adjacent Ozark Uplands are similar in character.

Biota:

The fish fauna is limited, consisting mostly of widely distributed Ozark and Prairie species that are rare and localized in occurrence in the Lowlands. The most characteristic of these are the central stoneroller, striped shiner, red shiner, creek chub, creek chubsucker, suckermouth minnow, and northeastern orangethroat darter. The gold-stripe darter has been recorded in Missouri only from a few creeks in Crowley's Ridge, and one Lowland spring.

These creeks are too short to exhibit much longitudinal zonation in the fish fauna.

Community Examples:

Unnamed creek in Holly Ridge Natural Area, Stoddard County; Rose Creek, Scott County; Wilson Creek, Stoddard County.





Cape LaCroix Springs, Scott County (Lowland Springs)

II. D. Lowland Springs

Distribution:

These occur along the margins of Crowley's Ridge and the Ozark Uplands.

Physical Features:

Only a few small springs occur in the Lowland Faunal Region. Some issue from carbonate rocks that outcrop along the boundary of the Ozark and Lowland faunal regions and in Crowley's Ridge. Others seep from sand and gravel deposits in Crowley's Ridge.

Biota:

The spring cavefish has been recorded west of the Mississippi River only from the outlet of a Lowland Spring

in Scott County. The goldstripe darter has been recorded in Missouri only from a Lowland Spring, and from streams fed by seep springs. Other Lowland fishes occur in the spring outlets, but they are not especially characteristic of this habitat.

A blind, white amphipod, *Bactrurus brachicaudus*, occurs in some Lowland springs, along with the widespread eyed and pigmented species *Crangonyx forbesi* and *Gammarus pseudolimnaeus*.

Community Examples:

Romine Spring, Butler County; Springs at Cape La-Croix bluffs, Scott County; seep springs at Holly Ridge Natural Area, Stoddard County.



Bourbeuse River, Franklin County (Ozark Region)

III. Ozark Faunal Region

Distribution:

This faunal region includes all of Missouri south of the Missouri River, between the Lowland Faunal Region to the southeast and the Prairie Faunal Region to the north and west. The boundary with the Lowlands is marked by an abrupt change in elevation of 50 to 250 feet. The boundary to the west and north is not consistently defined by any physiographic feature, but generally parallels the following Ozark streams and stream divides: starting at the Kansas state line on the southwest it includes the Spring river drainage, exclusive of the North Fork and a few other minor streams; in the Osage System it includes Cedar Creek and parallels the Sac River downstream to the Osage, thence downstream along the Osage River to the mouth of South Grand River; from this point it follows the divide separating the Osage and Moreau rivers from other drainages to the north and west; between the mouths of the Moreau River and Femme Osage Creek it parallels and lies south of the Missouri River, but includes tributaries north of the Missouri River in Warren County; at Femme Osage Creek it crosses into the Meramec Drainage and parallels the lower Meramec to its junction with the Mississippi River.

Physical Features:

The Ozark Faunal Region is largely co-extensive with the Ozark Plateaus Physiographic Province, and is characterized by older bedrocks, higher elevations, and greater local relief than surrounding areas. The bedrocks are mostly Mississippian in age or older, and consist principally of limestones and dolomities. These bedrocks surround a tract of pre-Cambrian igneous knobs in the southeastern part of

the region, and are capped by Pennsylvanian shales in some uplands on the northeast. Uplands in the Ozarks are commonly above 1,000 feet. Local relief along the major streams often exceeds 300 feet.

The streams typically occupy narrow, steep-sided valleys, and are frequently bordered by high bluffs. Stream channels consist of a series of well defined riffles and pools. Stream gradients are high, generally exceeding 3 feet per mile in even the larger streams. Substrates of coarse gravel, rubble, boulders and bedrock predominate. The water is



generally quite clear. Base flows are maintained by numerous springs. Some springs have a flow equal to that of a small river, and conditions suitable for cool-water fish are maintained for many miles in the stream channel.

Biota:

The fish fauna of the Ozark Faunal Region is richer and more diverse than that of other faunal regions. Fifty-six species and subspecies (chain pickerel, river redhorse, rock bass, Ozark bass, redear sunfish, largescale stoneroller, silverjaw minnow, bigeye chub, redspot chub, bluntface shiner, cardinal shiner, whitetail shiner, wedgespot shiner, Ozark minnow, Ozark shiner, dusky stripe shiner, telescope shiner, spotfin shiner, steelcolor shiner, bleeding shiner, southern redbelly dace, eastern slim minnow, creek chub-sucker, Ozark cavefish, southern cavefish, northern studfish, plains topminnow, northern brook lamprey, southern brook lamprey, least brook lamprey, American brook lamprey, streamline chub, Ozark madtom, mountain madtom, checkered madtom, Neosho madtom, greenside darter, rainbow darter, White River saddled darter, Current River saddled darter, barred fantail darter, golden fantail darter, yoke darter, least darter, Niangua darter, stippled darter, Current River orangethroat darter, Missouri saddled darter, banded darter, bluestripe darter, gilt darter, longnose darter, stargazing darter, mottled sculpin, Ozark sculpin, and banded sculpin) are restricted to the Ozarks or have only a limited distribution elsewhere in Missouri. Other characteristic Ozark fishes include: northern hog sucker, black redhorse, shadow bass,

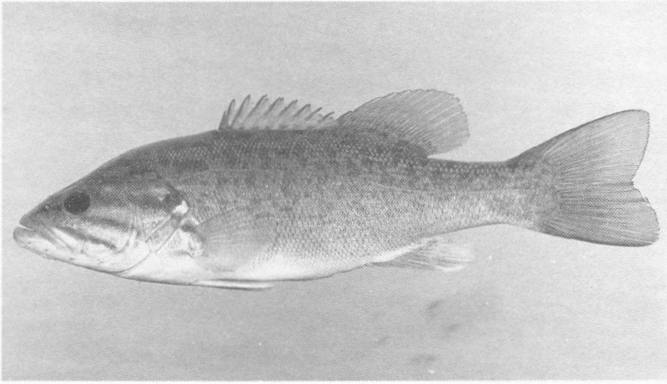
smallmouth bass, hornyhead chub, bigeye shiner, striped shiner, rosyface shiner, gravel chub, slender madtom, and striped fantail darter.

Amphibians and reptiles that are similarly restricted to the Ozarks include the hellbender, ringed salamander, spotted salamander, longtail salamander, darksided salamander, cave salamander, Oklahoma salamander, four-toed salamander, Ozark zigzag salamander, slimy salamander, southern red-back salamander, grotto salamander, wood frog, and yellow mud turtle.

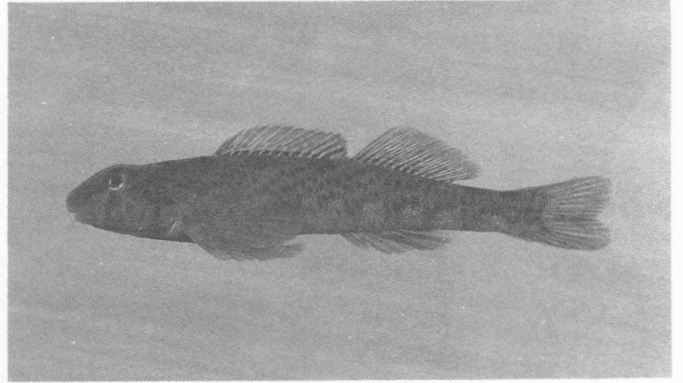
Twenty species and subspecies of crayfish are also largely restricted to the Ozark Faunal Region. These include Hubbs' crayfish, Salem cave crayfish, freckled crayfish, bristly cave crayfish, coldwater crayfish, black banded crayfish, woodland crayfish, longpincer crayfish, golden crayfish, midget crayfish, Mammoth Spring crayfish, saddle-backed crayfish, Meek's crayfish, gapefingered crayfish, excavator crayfish, ringed crayfish, Ozark crayfish, Big Creek crayfish, spothanded crayfish, and St. Francis River crayfish.

Mussels that are largely restricted to the Ozark Region include the spectacle case, cylindrical paper shell, squaw-foot, slipper shell, salamander mussel, fluted shell, rabbit's foot, Ozark shell, bullhead, kidney-shell, western fan shell, Ellipse, Plea's mussel, scale shell, little purple, rainbow shell, little spectacle-case, Neosho mucket, Reeve's mussel, (3 subspecies), pink mucket, elephant's ear, snuff box, and Curtis' shell.

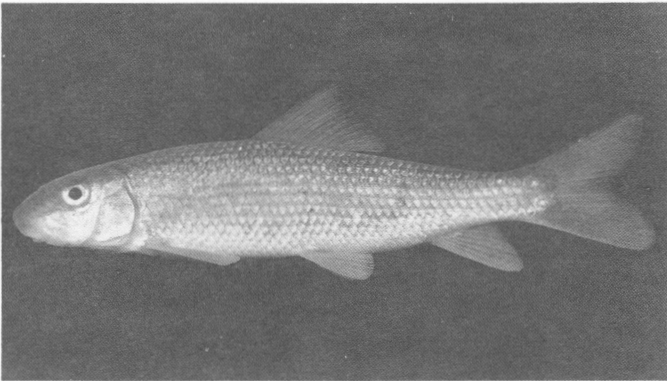
Animals of the Ozark Faunal Region



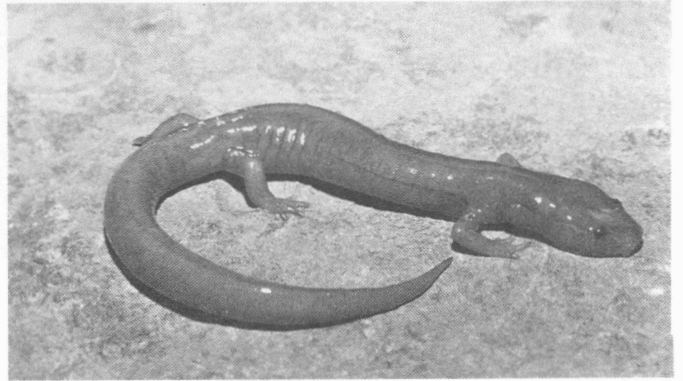
Smallmouth bass



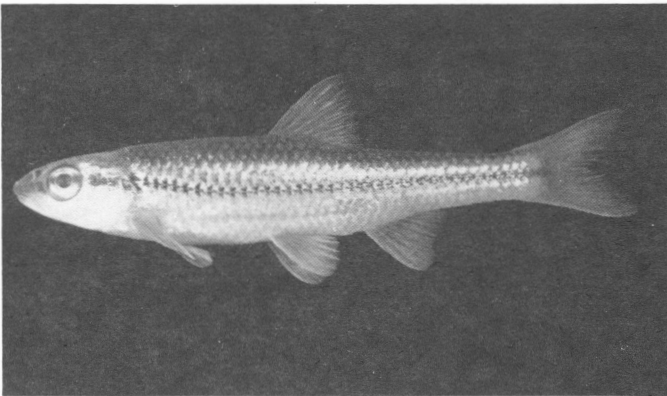
Greenside darter



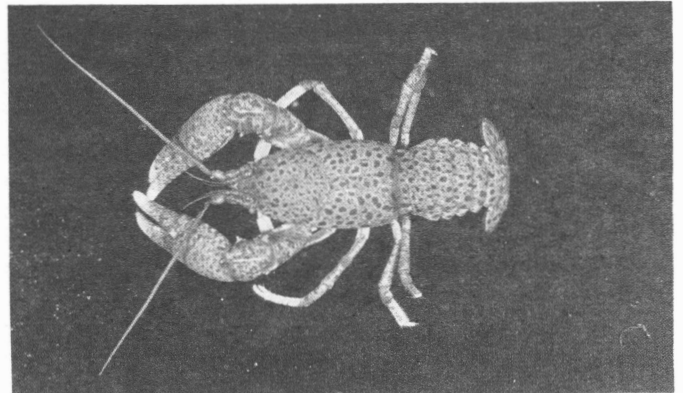
Black redhorse



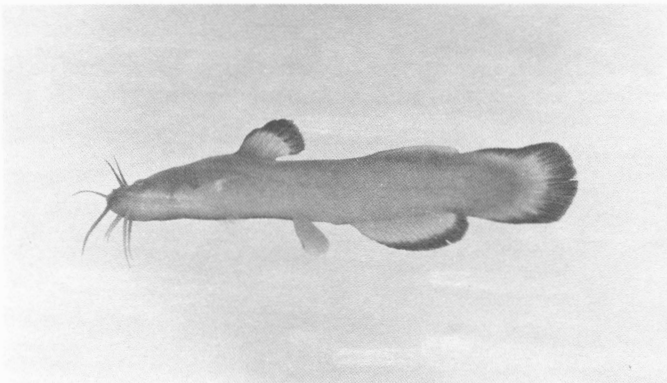
Grotto Salamander



Ozark minnow



Freckled crayfish



Slender madtom



Spectacle case mussel

Longitudinal Zonation

In Ozark stream there are regular and more or less predictable changes in physical factors and faunal composition as one progresses from the extreme headwaters towards the stream mouth. I used these changes to recognize four fish community zones: Headwater, Creek, Small River, and Large River. Since many of the features that characterize a particular zone are similar for all Ozark streams, a general discussion of these zones is presented here to avoid repetition in discussing zonation within the various Ozark Divisions.

Headwater Zone

Distribution:

This zone includes stream reaches upstream from miles-to-headwater 6 that are order I, II, or III. Stream reaches that are order IV or V are placed in the Creek Zone even if they fit the miles-to-headwater criterion for headwaters.

Physical Features:

Headwaters typically occupy shallower valleys but have steeper gradients than larger Ozark streams. At 104 Headwater localities, the local relief averaged 185 feet, and the

stream gradient averaged 46.6 feet/mile. The stream channel consists of a rapid succession of short pools and well defined riffles. The substrate generally consists of coarse gravel and rubble, often with long stretches of bedrock. Springs and spring seeps are sometimes numerous but are usually small. Many Ozark Headwaters are reduced to a series of isolated pools in late summer, while others may be entirely dry for long stretches.

Biota:

The fish fauna is characterized by a few widespread species, most of which reach their greatest abundance in habitats having limited faunas. In our samples from Headwater localities, the average number of species per sample was 10.4 and the Margalef Diversity Index averaged 1.16. The most abundant large fish at Headwater localities was almost invariably the green sunfish, the most abundant nektonic fishes were the central stoneroller and southern redbelly dace, and the most abundant benthic fishes were the orangethroat darter and fantail darter. The creek chub and stippled darter were often abundant and were particularly characteristic of Headwaters. The Ozark sculpin was abundant in Headwaters receiving much spring flow.

Water cress was common along spring-fed Headwaters, but other aquatic plants were sparse.



Little Sugar Creek, McDonald County (Neosho/Creek)

Creek Zone

Distribution:

This zone includes stream reaches of miles-to-headwater 7-31 and order V or less, and also streams less than miles-to-headwater 7 if their order is IV or V.

Physical Features:

Creeks occupy deeper valleys and have lower gradients than Headwaters. At 336 Creek localities the local relief averaged 223 feet and the gradient averaged 12.5 feet/mile. Pools are longer and deeper than in Headwater reaches and occasional deposits of detritus, sand, and silt are present. Chert gravel accumulates to considerable depths in the stream channel, and often forms large unstable bars. Creeks frequently cease to flow in late summer, but permanent pools are maintained by seepage through the bars that separate them.

Biota:

The fish fauna is richer in species and more diverse than in the Headwater zone. At Creek localities the number

of species per sample averaged 20.6 and the Margalef Diversity Index averaged 2.32. The longear sunfish generally replaces the green sunfish as the most abundant species of large fish, and is often joined by the rock bass (or its close relatives the Ozark bass or shadow bass), the smallmouth bass and the largemouth bass. The northern hog sucker, golden redhorse, and black redhorse are often common. Usually, the central stoneroller and southern redbelly dace are still prevalent, but are less abundant than the bleeding shiner (or its close relatives the cardinal shiner or dusky-stripe shiner) and the Ozark minnow. The creek chub is largely replaced by the hornyhead chub (or its close relative the redspot chub).

Other common nektonic species include the bluntnose minnow, redbfin shiner, striped shiner, bigeye shiner, and studfish. The rainbow darter replaces or is co-dominant with the orangethroat darter in many Ozark Creeks. Other benthic species listed for Headwaters are still common, and are usually joined by the greenside darter and slender madtom.

Aquatic vegetation is sparse along many Ozark Creeks, but water willow and yellow pond lily are often present along the margins of the more stable channels.



Elk River, McDonald County (Neosho/Small River)

Small River Zone

Distribution:

This zone includes all stream reaches of miles-to-headwater 32-96 and stream order VI or less, and also reaches of miles-to-headwater 31 or less if they are order VI.

Physical Features:

The valley is broader but deeper than in the Creek Zone, and the stream is often bordered by high limestone bluffs. At our stations the local relief averaged 271 feet and the gradient averaged 5.0 feet/mile. In Small Rivers the stream pools are often long and deep, and sand and silt bottoms are common. Large springs are present along many streams of this zone, and these have a marked effect on the flow characteristics and temperature. Small Rivers generally have permanent flow across their riffles, even in the most severe droughts.

Biota:

The fish fauna is richer in species and diversity than in Ozark Creeks. In our samples the number of species per

sample averaged 28.0 and the Margalef Diversity Index averaged 2.84. The composition and relative abundance ranking of the larger species is similar in Small Rivers and Creeks, except that the green sunfish dropped from second to seventh in ranking in our samples, and the gizzard shad was among the 10 most common species. The bleeding shiner (or its close relatives the cardinal shiner or dusky-stripe shiner) and the Ozark minnow are usually the most abundant minnows. In drainages where they occur, the principal change in nektonic fishes is the increased abundance of the bigeye chub, rosyface shiner, wedgespot shiner and largescale stoneroller. The latter species replaces the central stoneroller as the most abundant *Campostoma* in many streams of the Small River Zone. The rainbow darter was more abundant than the orangethroat darter in most samples from drainages where both occurred. The fantail darter, stippled darter and slender madtom are less abundant than in the Creek Zone, while abundance of the banded darter and Missouri (or Arkansas) saddled darter increases.

Extensive beds of water willow border most riffles, and yellow pond lily is common along the margins of pools. Submergent aquatic plants, including water milfoil, American pondweed, and coontail abound in quiet pools and backwaters.



Spring River, Jasper County (Neosho/Large River)

Large River Zone

Distribution:

This zone includes stream reaches of miles-to-headwater 97 or greater unless they are order VIII, and all reaches of order VII.

Physical Features:

Large Rivers occupy wide but relatively deep valleys. Local relief is generally higher than in Small Rivers, and the stream gradient is less. At Large-River stations the local relief averaged 297 feet and the gradient averaged 2.6 feet/mile. The river channel consists mostly of long pools and deep chutes. Backwaters and cut-offs are more extensive than along smaller Ozark streams. Sand and silt substrates predominate in backwaters and deeper pools. The swifter areas are floored by rounded gravel and rubble.

Biota:

The trend towards increasing species richness and diver-

sity continues in Large Rivers. In our samples the average number of species per sample was 36.1 and the Margalef Diversity Index averaged 2.88. The shorthead redhorse and channel catfish were among the 10 most abundant species, and the gizzard shad ranked fifth. The longnose gar, river carpsucker, flathead catfish, spotted bass, walleye, and freshwater drum comprised significant components of the fish community. The bleeding shiner is often abundant in large rivers, but the Ozark minnow tends to be much less abundant than in smaller Ozark streams. The rosyface shiner and wedgespot shiner usually are among the abundant nektonic fishes. The principal feature of the benthic fish community in our samples from large Ozark Rivers was the emergence of the gravel chub (or related streamline chub), gilt darter, banded darter, and Missouri (or Arkansas) saddled darter as the most abundant species.

Water willow and yellow pond lily are less prevalent in Large Ozark Rivers due to the reduction in stable gravelly or rocky substrate. Extensive beds of eel grass and water star grass are often present. Lizard's tail and rose mallow are sometimes common along the margins of backwaters and cut-offs.



Big Sugar Creek, Barry County (Neosho/Headwater)

III. A. Ozark-Neosho

Distribution:

This division includes all streams of the Neosho Drainage (Arkansas River System) in southwestern Missouri except for northern tributaries of Spring River from (and including) the North Fork west to the Kansas state line. Dry Fork, a tributary of the North Fork, is classified as Ozark-Neosho except for its headwater zone.

Physical Features:

The Ozark-Neosho Division is entirely within the Springfield Plateau physiographic division of the Ozark Uplands. Local relief and stream gradients are generally less than in other Ozark divisions. Springs are numerous, but most are small. Streams along the northern and western border of this division are broadly transitional with those of the adjacent Prairie Region, while those to the south and east are Ozarkian in character and very clear.

Biota:

The fish fauna of the Ozark-Neosho Division is the most distinctive of any major Ozark division, including a number of species that do not occur elsewhere in Missouri. Among these are the redspot chub, bluntface shiner, cardinal shiner, southwestern mimic shiner, western slim minnow, Neosho madtom, Arkansas darter, Neosho orangethroat darter, redfin darter, and channel darter. Several fishes that are otherwise widespread in the Ozarks are not native to the Neosho Division. These include the largescale stone-roller, hornyhead chub (replaced by redspot chub), bleeding shiner, blackspotted topminnow, northern studfish (recently introduced), rainbow darter, gilt darter, and Ozark sculpin.

The affinity of the Ozark-Neosho Division with the Ozark-Missouri Division is indicated by the mutual occurrence of a number of Ozark and Prairie species, including the rock bass (introduced), orangespotted sunfish, gravel chub, red shiner, spotfin shiner, western redfin shiner, suckermouth minnow, stonecat, plains topminnow, least darter, and Ozark logperch. Contrary to this pattern of distribution, the speckled darter is shared by the Ozark-Neosho and Ozark-White divisions.



Longitudinal zonation of the fish fauna differs from other Ozark divisions because of the presence of restricted species and absence of otherwise widespread Ozark species as listed above. Particularly noteworthy is that the orange-throat darter (Neosho subspecies) is much more common in the Creek and Small River zones than this species is in other Ozark divisions, perhaps because a potential competitor, the rainbow darter, is absent. The Arkansas darter is especially characteristic of the Headwater Zone. The blunt-face shiner, southwestern mimic shiner, and western slim minnow often lend a distinctive character to the Small River, and more particularly the Large River zones. The Neosho madtom was recorded only in the Large River Zone. Prairie species, including the suckermouth minnow, red shiner, and orangespotted sunfish are more prevalent in larger streams of the Neosho Division than in any other Ozark Division.

The yellow mud turtle is known only from the Neosho Division, while the Oklahoma salamander and Ozark zigzag salamander are shared with the White River Division. The greybelly salamander is also largely restricted to these two

Ozark Divisions.

Crayfish restricted in Missouri to the Neosho Division include the Neosho midget crayfish and ringed crayfish. The northern crayfish is widespread in this division. The Neosho mucket mussel is restricted to this division.

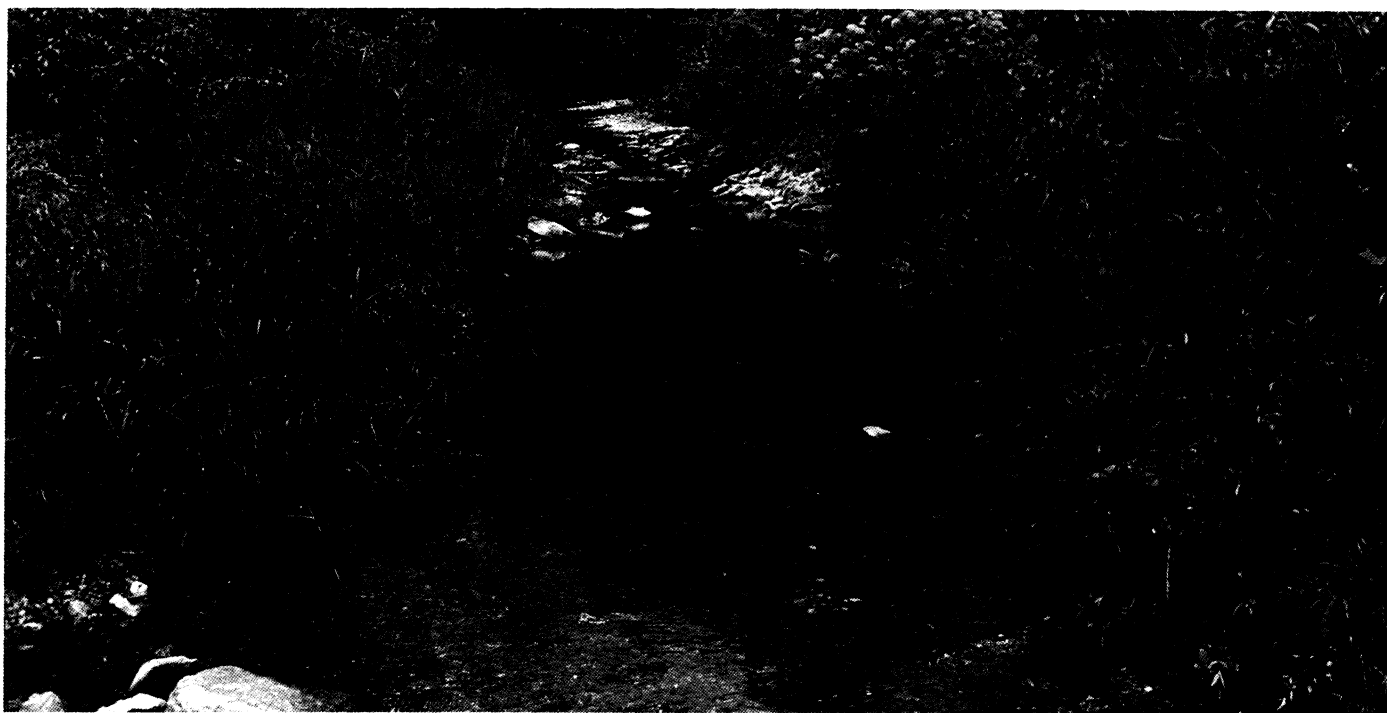
Community Examples:

Headwaters: Wolf Pen Hollow, McDonald County; Cedar Creek, Newton County; Truitt Creek, Lawrence County.

Creek: Indian Creek, McDonald County; Capps Creek, Newton County; White Oak Creek, Jasper County.

Small River: Elk River, McDonald County; Shoal Creek, Newton County; Spring River, Lawrence County.

Large River: Spring River (below mouth of North Fork), Jasper County.



Wheeler's Branch, Stone County (White/Headwater)

III. B. Ozark-White

Distribution:

This division includes all streams of the White River drainage in the southern Ozarks.

Physical Features:

The Ozark-White Division encompasses portions of the Springfield Plateau and Salem Plateau physiographic divisions of the Ozark Uplands. Local relief is exceeded only by that in the St. Francis Mountains, with ridge tops standing 300-600 feet above the beds of the major streams. The streams have high gradients and are generally very clear. Springs are numerous, and some are quite large.

Biota:

Four species or subspecies of fishes are restricted in Missouri to the White River Division. These are the Ozark bass (introduced into the Sac River of the Ozark-Missouri Division), dusky stripe shiner, White River saddled darter, and the Yoke darter. White River populations of the following species are morphologically distinct, and may represent geographic races or undescribed subspecies: longear sunfish, rainbow darter, fantail darter, and orangethroat darter.

The affinities of the Ozark-White Division with the Ozark-Black and Ozark-Southeast divisions is indicated by the mutual occurrence of the least brook lamprey (known from one locality in the Ozark-Mississippi division), stream-line chub, whitetail shiner, Ozark shiner, telescope shiner, eastern slim minnow (probably now extinct in the White), Ozark madtom, checkered madtom, Arkansas saddled darter, Ohio logperch, and longnose darter. Mutual affinities with the Ozark-Neosho Division are indicated by occurrence of the stippled darter which is absent from the Ozark-Black Division.

Longitudinal zonation in streams of this division differ from the general description for Ozark streams in the following respects. Large fishes were scarce in samples from Ozark-White Headwaters, with no species recorded in more than 15 percent of the samples. The telescope shiner was a characteristic minnow of Creeks, while the whitetail shiner was characteristic of the Small River Zone and more particularly the Large River Zone of this and other southern Ozark divisions. Fantail darters are uncommon in all streams of the Ozark-White Division. Two subspecies (one undescribed) are present. The yoke darter is especially characteristic of the Small River Zone, and the Arkansas saddled darter (White River subspecies) is characteristic of the Large



River Zone. The Ozark hellbender is restricted to the Ozark-White Division (North Fork Drainage) and the Ozark-Black Division.

The longpincered crayfish, Meek's crayfish, and excavator crayfish are known in Missouri only from the Ozark-White Division. The gapefingered crayfish is endemic to the North Fork drainage, intergrading with the ringed crayfish westward in the Ozark-White Division. The Ozark crayfish and spothanded crayfish are also common, but the latter species is absent from the western part of this division.

Community Examples:

Headwater: Panther Creek, Texas County; Tarbutton Creek, Douglas County; Silver Lake Branch, Stone County.

Creek: Spring Creek, Howell County; Cowskin Creek, Douglas County; Bull Creek, Taney County.

Small River: James River, Greene County; Beaver Creek, Taney County; Bryant Creek, Ozark County.

Large River: James River, Stone County; North Fork River (below Bryant Creek), Ozark County.



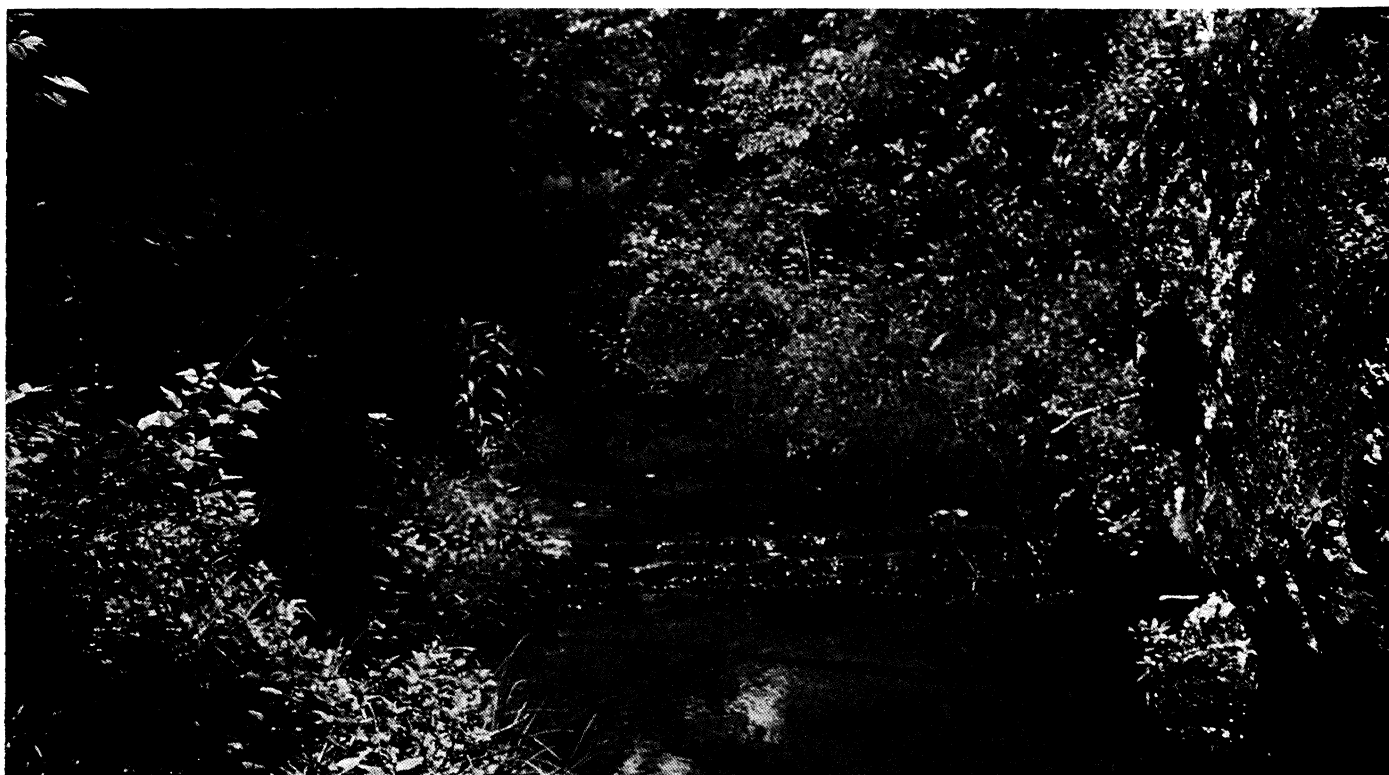
Little Indian Creek, Stone County (White/Creek)



Finley River, Christian County (White/Small River)



James River, Stone County (White/Large River)



Barn Hollow Creek, Texas County (Black/Headwater)

III. C. Ozark-Black

Distribution:

This division includes all streams of the Black River System within the Ozark Uplands Physiographic Region, from Spring River in Howell County eastward to the Black River in Butler, Wayne, and Reynolds counties.

Physical Features:

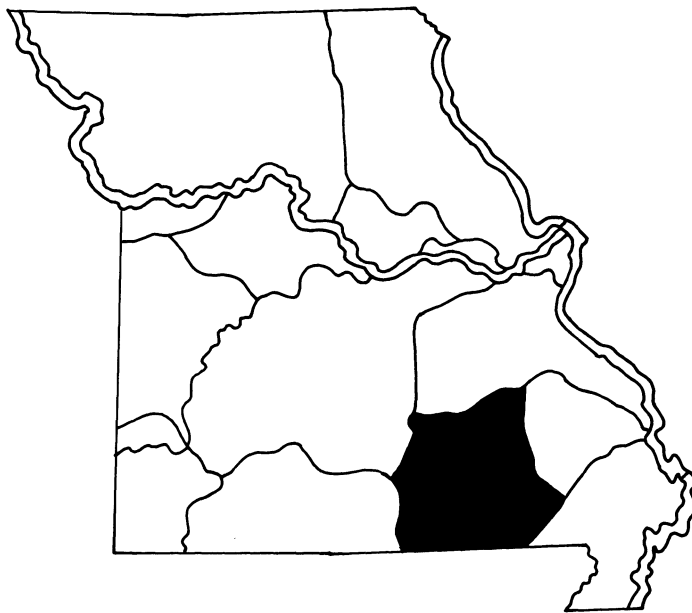
The Ozark-Black Division is mostly within the Salem Plateau subdivision of the Ozark Uplands, but also drains the western slope of the St. Francis Mountains. The topography is deeply and intricately dissected, with high local relief. The streams have high gradients and are very clear. The three largest springs in the Ozarks occur here, and numerous springs of a lesser magnitude are also present.

Biota:

Fishes that are restricted to the Ozark-Black Division include the Current River saddled darter, barred fantail darter, and Current River orangethroat darter. This division shares a number of species with the Ozark-Southeast Division that are absent from the adjacent Ozark-White Division. These include the American brook lamprey, chain pickerel, eastern redbfin shiner, bleeding shiner, Mississippi silvery minnow, spotted sucker, mountain madtom, warmouth, spotted sunfish (recorded from one locality in the Ozark-White), shadow bass, johnny darter, and stargazing darter. The checkered madtom and Arkansas saddle darter occur in the Ozark-Black and Ozark-White divisions, but not in the Ozark-Southeast Division. The steelcolor shiner, stippled darter and longnose darter have been recorded in the Ozark-White and Ozark-Southeast divisions, but not in the intervening Ozark-Black division.

The most distinctive feature of longitudinal zonation in the Ozark-Black Division is the prevalence of Lowland fishes in the lower sections of the larger rivers. Some of the more common Lowland fishes are the warmouth, spotted sunfish, Mississippi silvery minnow, ribbon shiner, blacktail shiner, northern mimic shiner, and bullhead minnow.

The coldwater crayfish and Mammoth Spring crayfish have been recorded in Missouri only from the Eleven Point and Spring River systems of the Ozark-Black Division. The Ozark crayfish has been recorded only from the Ozark-Black and Ozark-White divisions, and the woodland crayfish



only from the Ozark-Black and Ozark-Mississippi divisions. Hubb's crayfish, spothanded crayfish, and the golden crayfish, are common in the Ozark-Black Division. Populations of the latter taxon are restricted to Current River in the Ozark-Black Division and may represent an undescribed species.

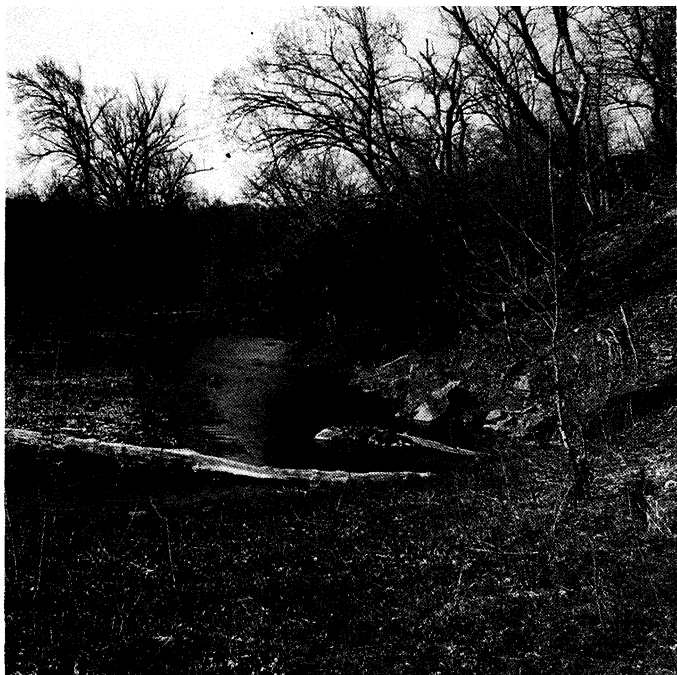
Community Examples:

Headwater: Well Hollow, Dent County; Goose Bay Creek, Shannon County; Clayton Creek, Iron County.

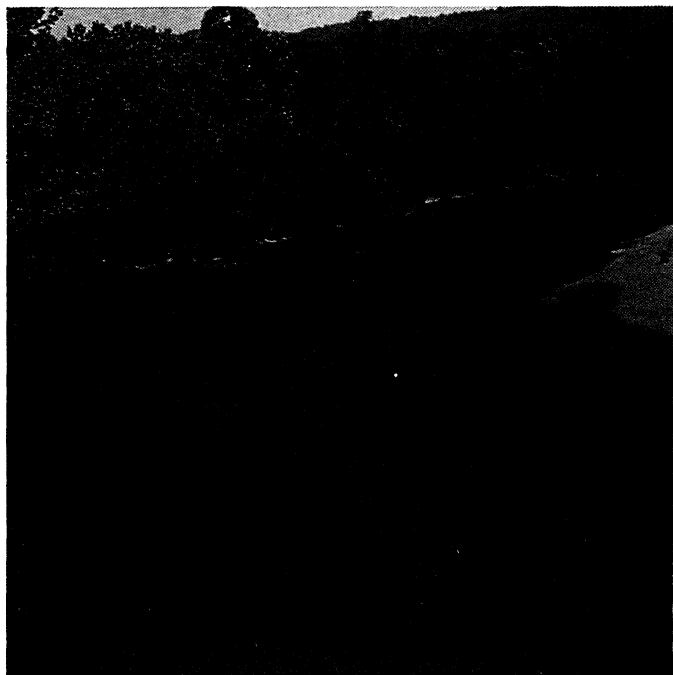
Creek: Ottery Creek, Reynolds County; Pigeon Creek, Dent County; Piney Creek, Oregon County.

Small River: Black River, Reynolds County; Jacks Fork River, Shannon County; Eleven Point River, Oregon County.

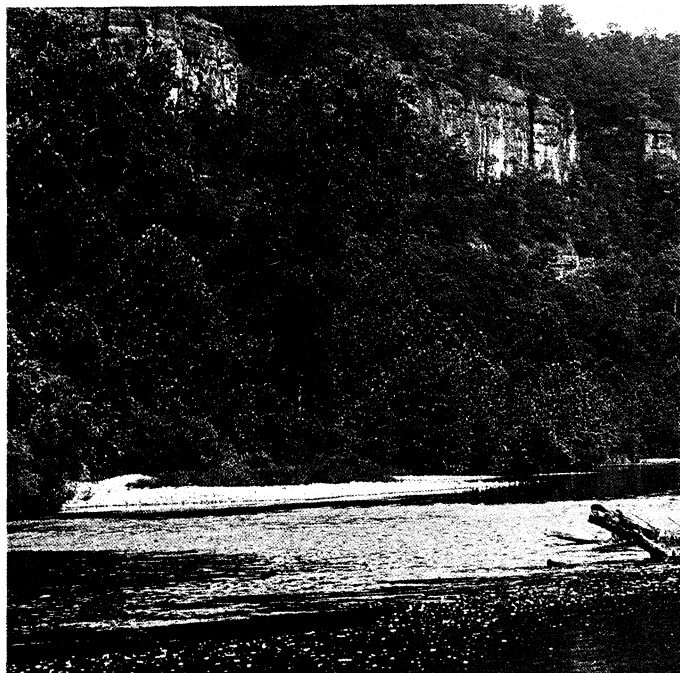
Large River: Black River, Wayne County; Current River, Ripley County.



Mahan Creek, Shannon County (Black/Creek)



Current River, Ripley County (Black/Large River)



Jacks Fork, Shannon County (Black/Small River)



Little Creek, Iron County (Southeast/Headwater)

III. D. Ozark-Southeast

Distribution:

This division includes streams of the St. Francis and Headwater Diversion stream systems, within the Ozark Uplands Physiographic Region.

Physical Features:

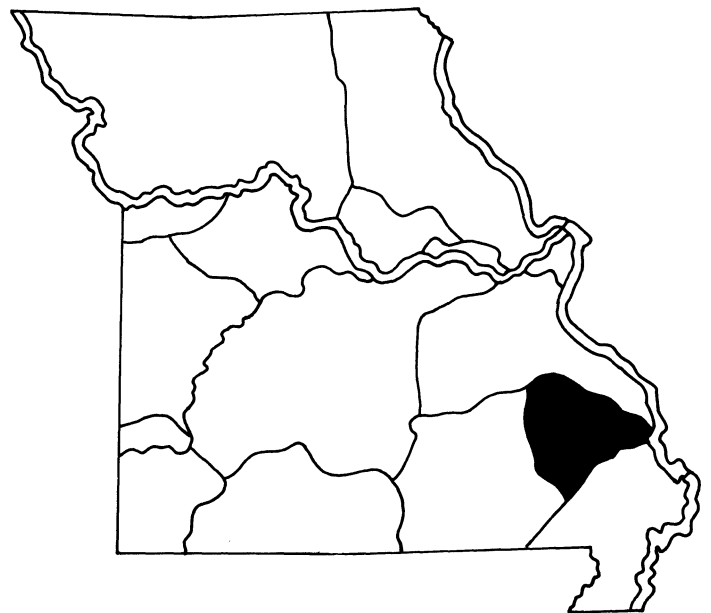
The Ozark-Southeast Division includes parts of the St. Francis Mountains Physiographic Division and adjacent parts of the Salem Plateau. The highest elevation and relief in Missouri occur in the St. Francis Mountains. The topography consists of irregularly-distributed igneous knobs surrounded by gently rolling basins floored by sedimentary rocks. The "shut-ins" formed where streams flow across the highly resistant igneous rocks are a characteristic feature of the streams. The topography of the Salem Plateau portion of the Ozark-Southeast Division is typical of that found elsewhere in the Ozarks. Few springs of any consequence occur in this Ozark Division.

Biota:

The Ozark-Southeast Division has no fish species that are unique to it. Rather, it is characterized by the particular combination of species found in adjacent divisions. It differs from the Ozark-Mississippi (and resembles other southern Ozark divisions) in the occurrence of the shadow bass, spotted bass, telescope shiner, whitetail shiner, Ozark shiner, eastern slim minnow, American brook lamprey, streamline chub, mountain madtom, Ozark madtom, Ohio logperch, longnose darter, and stargazing darter.

Numerous Lowland species occur peripherally in the Ozark-Southeast, but are absent from the Ozark-Mississippi.

The steelcolor shiner, one of the common minnows in the Ozark-Southeast Division, and the longnose darter are absent from the Ozark-Black. The checkered madtom and Arkansas saddled darter are present in other southern Ozark divisions but absent from the Ozark-Southeast Division. The St. Francis Mountain part of the Ozark-Southeast division is characterized by the scarcity of certain otherwise widespread Ozark fishes. These include the Ozark minnow, bleeding shiner, southern redbelly dace, and Ozark sculpin.



Longitudinal zonation of fish communities in this division is modified somewhat by scarcity of the common Ozark species listed above, and their replacement by species more typical of warmer, quieter waters. The creek chub comprises a greater proportion of the nektonic fishes in Headwaters of this division than any other Ozark division. The spotted bass is one of the common large fishes in the Creek, Small River, and Large River zones. The Mississippi silvery minnow, bluntnose minnow, bigeye shiner, and steelcolor shiner are among the common nektonic fishes in the river zones. The speckled darter and scaly sand darter are also common in the river zones. The crystal darter was also rather common in this zone until recent decades.

The Big Creek crayfish and St. Francis River crayfish are endemic to the Ozark-Southeast Division. Hubb's crayfish and the golden crayfish are common, but are shared

with some other Ozark divisions. The spothanded crayfish is uncommon in this division, and appears to be morphologically distinct from other populations of the species.

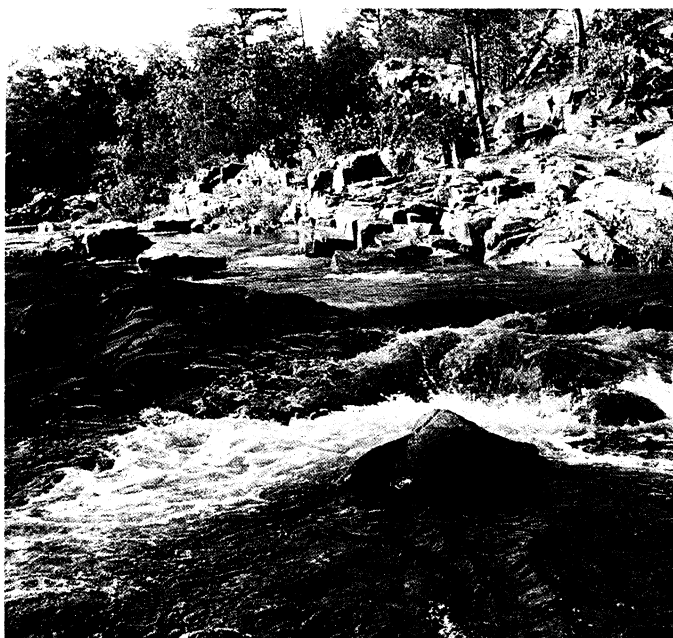
Community Examples:

Headwater: Claybaugh Creek, Iron County; Lower Rock Creek, Madison County; Pond Creek, Bollinger County.

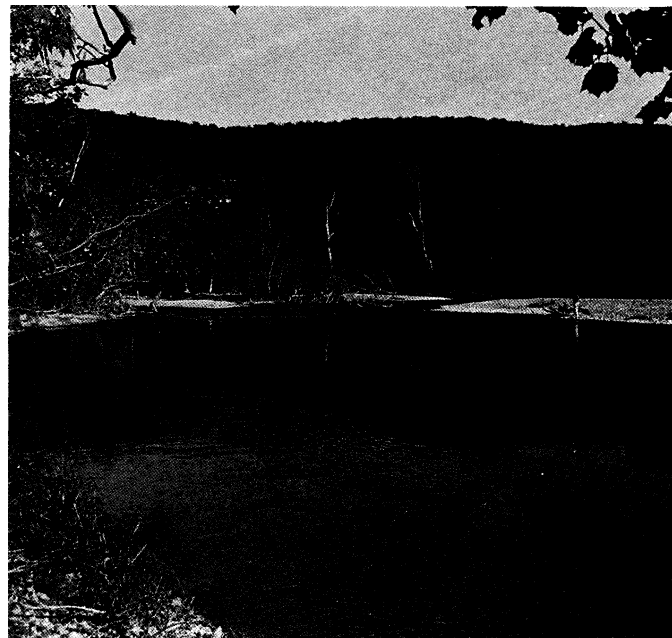
Creek: Marble Creek, Iron County; Twelve Mile Creek, Madison County; Crooked Creek, Bollinger County.

Small River: St. Francis River, Madison County; Castor River, Bollinger County; White-water River, Cape Girardeau County.

Large River: St. Francis River, Wayne County.



Marble Creek, Iron County (Southeast/Creek)



St. Francis River, Wayne County (Southeast/Large River)



Big Creek, Wayne County (Southeast/Small River)



Coonville Creek, St. Francois County (Mississippi 1/Headwater)

III. E. Ozark-Mississippi

Distribution:

This division includes direct tributaries of the Mississippi River from Cape Girardeau northward to and including the Meramec stream system.

Physical Features:

This division is mostly within the Salem Plateau, but also includes part of the St. Francis Mountains. Most of the topography is deeply dissected with high relief, but undissected upland plains are more extensive towards the north and west. I recognize two subdivisions of the Ozark-Mississippi Division, and the physical features of these will be discussed in more detail in their respective sections.

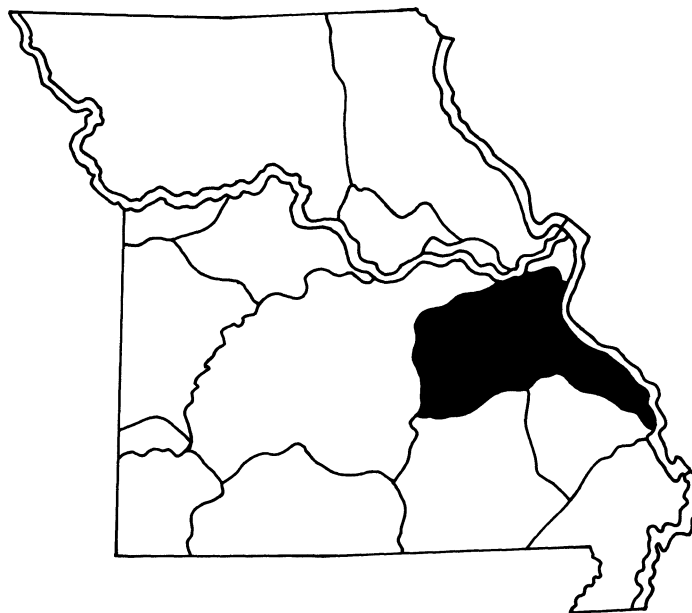
Biota:

The Ozark-Mississippi Division has no fish species that are restricted to it. Rather, it is characterized by a unique combination of the species present in adjacent Ozark divisions. The silverjaw minnow is nearly restricted in Missouri to the Ozark-Mississippi Division, having been recorded from only one locality in the Ozark-Southeast Division. The rock bass was probably restricted in Missouri to the Ozark-Mississippi Division until its introduction into other Ozark divisions. Species occurring in the Ozark-Mississippi but not in the Ozark-Southeast include the rock bass, sand shiner, spotfin shiner, northern brook lamprey, gravel chub, stonecat, Missouri saddled darter and Ozark logperch. Spawning of the Alabama shad in Missouri may occur only in large rivers of this division and the Ozark-Missouri Division. Species in the Ozark-Mississippi Division but not in

the Ozark-Missouri Division include the grass pickerel, bigeye chub, eastern redbfin shiner, steelcolor shiner, silverjaw minnow, and creek chubsucker.

The eastern hellbender is shared by the Ozark-Mississippi and Ozark-Missouri divisions.

Two subdivisions of the Ozark-Mississippi Division are recognized.



III. E. 1. Ozark-Mississippi 1

Distribution:

This subdivision includes direct tributaries of the Mississippi River from Cape Girardeau northward, and the Meramec stream system exclusive of the Bourbeuse and Dry Fork drainages.

Physical Features:

The topography of this subdivision is more deeply and intricately dissected than that of the Ozark-Mississippi 2 Subdivision, and local relief and stream gradients are higher. Springs are numerous, and the streams are generally very clear.

Biota:

The Ozark-Mississippi 1 Subdivision supports certain common and characteristic Ozark fishes that are uncommon or absent in the Ozark-Mississippi 2 Subdivision. Examples include the wedgespot shiner, bleeding shiner, Ozark minnow, southern redbelly dace, blackspotted topminnow, northern brook lamprey, and Ozark sculpin. The hornyhead chub and bigeye chub are still common and widespread in the Ozark-Mississippi 1 Subdivision, but seem to have disappeared from the Ozark-Mississippi 2 Subdivision within the last 45 years.

Crayfish species known only from the Meramec Drainage in The Ozark-Mississippi 1 Subdivision are the freckled crayfish, blackbanded crayfish (known from one locality in the Ozark-Southeast Division where it may be introduced), and the saddledbacked crayfish. The golden crayfish and spothanded crayfish are quite common.

Longitudinal zonation in this subdivision agrees in most respects with the general description for Ozark streams given previously. However, the spotfin and steelcolor shiners are among the dominant Nektonic fishes in the Large River Zone.

Community Examples:

Headwater: Coonville Creek, St. Francis County; Guyser Hollow, Iron County; Possum Trot Creek, Crawford County.

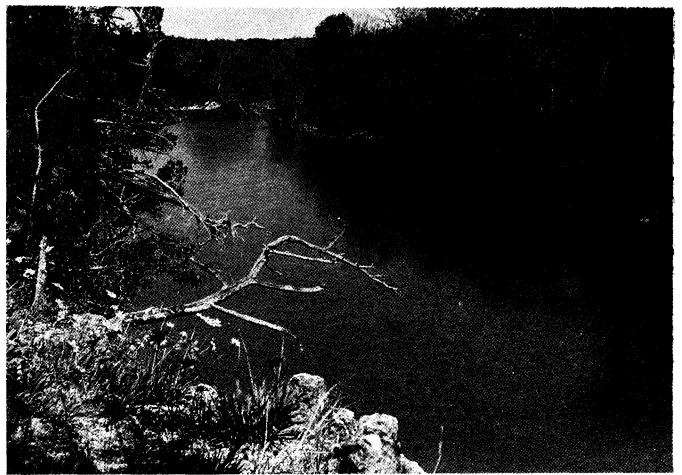
Creek: Jonca Creek, Ste. Genevieve County; Fox Creek, St. Louis County; Mineral Fork, Washington County.

Small River: Meramec River, Crawford County; Huzzah Creek, Crawford County; Big River, St. Francois County.

Large River: Meramec River, Franklin County; Big River, Jefferson County.



Terre Bleue Creek, St. Francois County (Mississippi 1/Creek)



Meramec River, Franklin County (Mississippi 1/Large River)



Big River, St. Francois County (Mississippi 1/Small River)



Humphrey Creek, Miller County (Missouri/Headwater)

III. F. Ozark-Missouri

Distribution:

This division includes all streams of the Ozark Region that drain into the Missouri River.

Physical Features:

This division is mostly within the Salem Plateau, but also includes part of the Springfield Plateau. A few small, direct tributaries drain the southern margin of the Dissected Till Plains. The topography is comparatively level and undissected to the south and west along the principal drainage divides, but is hilly and deeply dissected to the north and east along the Osage and Gasconade rivers. Local relief and stream gradients are comparable to or slightly higher than in the Ozark-Mississippi Division. The streams of the Salem Plateau are generally clearer and have more extensive exposures of chert in their channels than streams of the Springfield Plateau.

Biota:

The Ozark-Missouri is the largest of the Ozark divisions, but has few species that are restricted to it. Rather, it is characterized by a unique combination of the species characteristic of other Ozark divisions. The Niangua darter and bluesripe darter are endemic to the Ozark-Missouri division, and the only populations of the blacknose shiner and mottled sculpin in the Missouri Ozarks are in the Ozark-Missouri Division. The Missouri saddled darter and the northern brook lamprey occur in Missouri only in the Ozark-Missouri and Ozark-Mississippi divisions.

Ozark populations of the western redbfin shiner and the plains topminnow are restricted to the Ozark-Missouri

and Ozark-Neosho divisions. The least darter is nearly restricted to these two divisions, having been recorded only once from the Ozark-Mississippi Division. The bigeye chub occurs in the Ozark-Mississippi and Ozark-Neosho divisions, but not in the Ozark-Missouri Division. The Ozark bass, an endemic of the Ozark-White Division, has been recorded at a few localities in the Ozark-Missouri Division, but these are thought to be the result of introductions by man.



Occurrence of the spotted bass and the rock bass in the Ozark-Missouri Division are also thought to be the result of introductions.

The eastern hellbender occurs in Missouri only in the Ozark-Missouri and Ozark-Mississippi divisions.

No crayfish are known to be endemic to the Ozark-Missouri division. Common species are the golden crayfish and spothanded crayfish. In this division, the latter species is restricted to the Gasconade River and its tributaries, and is replaced by the northern crayfish in the Osage River System.

Longitudinal zonation in streams of the Ozark-Missouri division does not differ notably from the general description previously given of longitudinal zonation in Ozark streams. In drainages where they occur, the Niangua darter and bluestripe darter lend a distinctive character to the Creek and Small River zones. One additional zone was recognized in the Ozark-Missouri Division to accommodate the lower Osage River. It is the only Order VIII stream in the Ozark Faunal Region, and has been considerably modified by the construction of Lake of the Ozarks and Truman Reservoir.

In spite of this, the fish fauna of the Osage Zone is in many respects an extension of the trends in species abundance evidenced by other zones. Thus, among large fishes,

the gizzard shad, shorthead redhorse, channel catfish, and spotted bass are among the common species. The abundance of bluegill (comprising nearly one-third of all large fishes) and to a lesser extent the white crappie, may result from influx of specimens from the reservoirs. Among nektonic species the emerald shiner is much more abundant than in other zones, and the bleeding shiner is far less abundant. In the benthic group the gravel chub is by far the most abundant, comprising 90 percent of all specimens. The gilt darter is also common.

Community Examples:

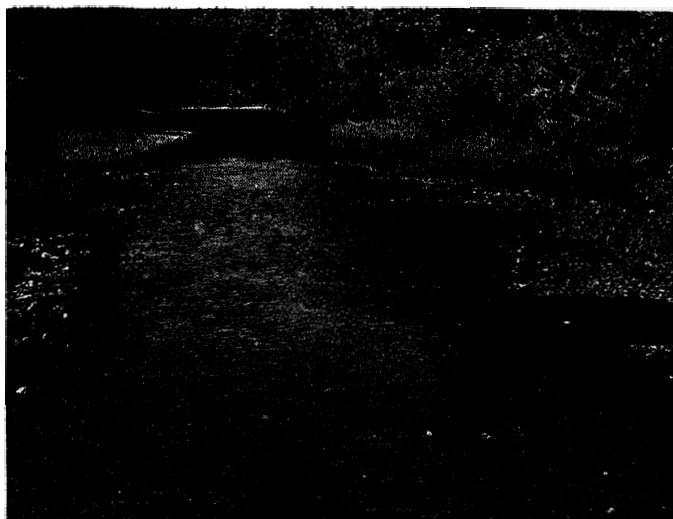
Headwater: Sycamore Creek, Greene County; Tick Creek, Phelps County; Massie Creek, Warren County.

Creek: North Dry Sac River, Green County; Barren Fork, Miller County; Potter Creek, Texas County.

Small River: Sac River, Dade County; Niangua River, Dallas County; Big Piney River, Texas County.

Large River: Gasconade River, Maries and Osage counties.

Osage: Osage River, Miller County.



Big Tavern Creek, Miller County (Missouri/Creek)



Osage River, Miller County (Missouri/Osage)



Gasconade River, Pulaski County (Missouri/Large River)



Greer Spring, Oregon County (Special Communities/Spring Branches)

III. G. Special Communities

III. G. 1. Spring Branches (Freshwater)

Distribution:

Springs and their branches are a characteristic feature of the Ozark landscape and they are inhabited by a characteristic assemblage of animals and plants that set them apart as a distinct aquatic community type.

Physical Features:

The greatest number and the largest springs in Missouri issue from dolomitic rocks of the Salem Plateau. A secondary area of springs is in limestone rocks of the Springfield Plateau. Temperature is an important factor affecting the distribution of the plants and animals of spring branches. At the spring source, the water temperatures is about 58°F year-round. As the water flows away from this source, it comes more and more under the influence of the air temperature, and ultimately takes on the fluctuating character of warmwater streams. The distance involved in affecting this change depends on the volume of flow and other factors. Some streams that receive one or more large springs remain cool enough to support a characteristic spring biota for many miles. Springs are subject to wide fluctuations in flow, but generally have better-sustained base flows than surface streams that are not spring-fed.

Biota:

The fish fauna of Ozark spring branches is quite limited. The chain pickerel and white sucker are characteristic large fishes in drainages where they occur, but are

restricted to the larger spring branches with well defined pools. The rainbow trout has been introduced into many spring branches, and a few self-sustaining populations have been established. The southern redbelly dace and creek chub are characteristic and generally distributed nektonic species. The bleeding shiner, central stoneroller, largescale stoneroller, blackspotted topminnow, and Ozark minnow are common in some spring branches.

Sculpins are the most abundant and characteristic benthic fishes in Ozark spring branches. The Ozark sculpin is the dominant species in most Ozark springs, but is absent from the Ozark-Neosho Division, where the banded sculpin is dominant. The mottled sculpin appears to be restricted to springs of the Ozark-Missouri Division. The orangethroat darter and rainbow darter are also common in many Ozark spring branches.

Several amphibians are characteristic of Ozark spring branches. These include the Ozark hellbender, dark-sided salamander, graybelly salamander, Oklahoma salamander, and pickerel frog.

Amphipods, isopods, and snails are often very abundant in Ozark Springs. Common amphipods include *Crangonyx forbesi*, *Gammarus minus*, and *Gammarus pseudolimnaeus*. *Asellus brevicauda* is one of the common isopods, and *Elmia potosiensis ozarkensis* is the most abundant and widely distributed snail. Flatworms recorded from Ozark springs include *Dugesia doratoccephala* and *Phagocata gracilis*.

Water cress is a characteristic plant of Ozark spring branches. Other common species include water milfoil, water starwort, elodea, and water speedwell.

Community Examples:

Greer Spring, Oregon County; Lane Spring, Phelps County; Hahatonka Spring, Camden County.



Midco Cave, Ripley County (Special Communities/Subterranean Streams)

III. G. 2. Subterranean Streams

Distribution:

The highly soluble carbonate rocks that underlie much of the Ozarks are honeycombed by an extensive network of subterranean drainage channels that are inhabited by a limited but unique biota.

Physical Features:

The two physical features of greatest importance in determining the nature of the biota of subterranean streams are the absence of light and the constant temperature. Because of the absence of light, virtually all the energy to support the biota must be imported into the system by way of organic material that washes in or is brought in by animals that forage outside the system. The temperature of subterranean streams is near 58°F year around.

Biota:

Plants, other than certain bacteria that reduce sulphur and other inorganic compounds as an energy source, are absent. Most of the animals restricted to subterranean

streams exhibit specific adaptations, such as an overall whitish or translucent color, and the reduction or loss of eyes. The two most characteristic fishes are the southern cavefish and Ozark cavefish. Some fishes that are more abundant in surface waters often occur in cave streams. The banded sculpin is the most common of these. The grotto salamander is the most characteristic amphibian in subterranean streams.

Two species of blind, white crayfish have been recorded from Ozark caves. These are the Salem cave crayfish in the eastern and northern Ozarks, and the bristly cave crayfish in the southwestern Ozarks. Many of the same amphipods and isopods that occur in springs also occur in their subterranean sources. There they are joined by other species more specialized for subterranean life, including *Bac-turus brachycaudus*, *Gammarus troglophilus*, and *Asellus antricolus*. The flatworm *Speophyla hubrichti* occurs in cave streams of the eastern Ozarks.

Community Examples:

Lewis Cave, Ripley County; Turnback Cave, Lawrence County; Onandaga Cave, Crawford County.



Overflow pool of St. Francis River, Madison County (Special Communities/Overflow Waters)

III. G. 3. Overflow Waters

Distribution:

This habitat occurs in abandoned stream channels throughout the Ozarks, particularly along the larger streams.

Physical Features:

Current is absent except when adjacent streams are in flood. The temperature is typically higher than in surface streams, unless the overflow pool is spring-fed. The substrate may be sand, gravel, or rubble, but these are often overlain by silt and organic debris.

Biota:

The fish fauna is usually a subset of that found in adjacent surface streams, but differing in relative abundance of the species. The large-fish fauna is comprised mostly of sunfish (Centrarchidae), including the bluegill, largemouth

bass, longear sunfish, green sunfish, and warmouth. The grass pickerel and chain pickerel are common in overflow pools within their ranges. Typical nektonic fishes include the blackspotted topminnow, redbfin shiner, striped shiner, bluntnose minnow, bigeye shiner, and golden shiner. Benthic fishes are scarce, with the orangethroat darter the most common species.

Amphibians and reptiles are often common in Ozark overflow waters. Typical species include bullfrog, green frog, southern leopard frog, common snapping turtle, red-eared slider, western painted turtle, and northern water snake.

Community Examples:

Long Bay, Carter County; Cardareva Bluff Slough, Shannon County; Millstream Garden Slough, Madison County.

Aquatic plants are often abundant, with water milfoil, hornwort, yellow pond lily, and water willow common.



Locust Creek, Sullivan County (Prairie)

IV. Prairie Faunal Region

Distribution:

This faunal region includes most of Missouri north of the Missouri River and a wedge-shaped area south of the Missouri River along the Kansas state line. The Prairie Faunal Region is set off from the Ozark Faunal Region by the boundary defined in the account for that region.

Physical Features:

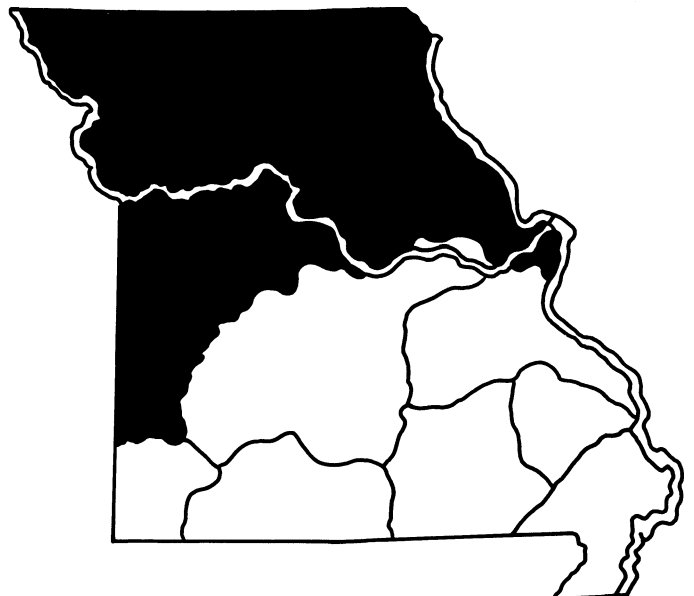
The Prairie Faunal Region is largely co-extensive with the Dissected Till Plains and Osage Plains physiographic regions. Pennsylvanian shales and thin sandstones are the principal bedrocks over much of the region, but Mississippian limestones similar to those underlying parts of the Ozark Region outcrop along the lower Missouri and upper Mississippi rivers. These bedrocks are covered in places by deep deposits of glacial till and loess. Elevations are nearly as high as in adjacent border areas of the Ozarks, but local relief seldom exceeds 200 feet and is typically much less.

The streams occupy relatively broad valleys that sometimes grade almost imperceptibly into the surrounding uplands. In their natural condition the streams had a meandering character and left many oxbows and sloughs as they changed their courses. The channel is typically bordered by high alluvial banks. The stream pools are generally quite long, and riffle sections are lacking or poorly defined in some streams. Silt and sand are common bottom types. The streams are frequently turbid. Large springs are lacking and the streams tend to be intermittent or have low base flows.

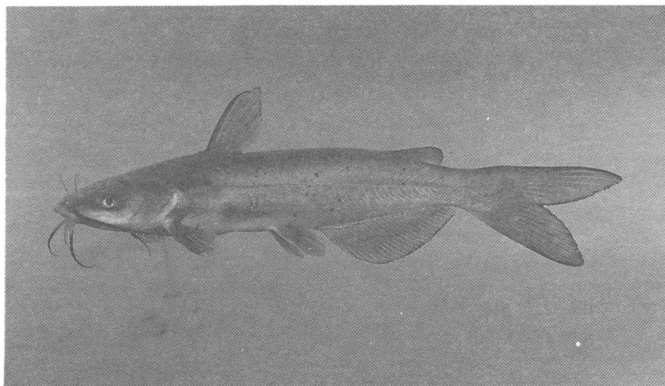
Biota:

The Prairie fauna is less diverse than that of other faunal regions, and many of the common species occur also

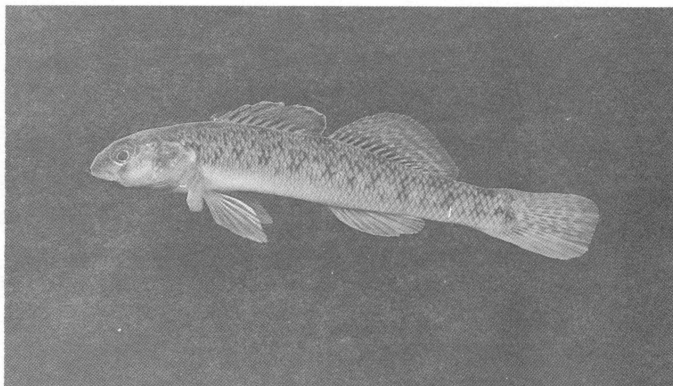
in parts of the Big River, Ozark, and Lowland faunal regions. Eight species and one subspecies of fishes (mud minnow, brassy minnow, common shiner, bigmouth shiner, Topeka shiner, fathead minnow, plains killifish, trout-perch, and plains orangethroat darter) have been recorded only in the Prairie Region or occur infrequently in other faunal regions. Common species that are especially characteristic of the Prairie Region include: common carp, river carp-sucker, quillback, white sucker, black bullhead, orange-spotted sunfish, red shiner, sand shiner, western redbfin shiner, creek chub, suckermouth minnow and johnny darter.



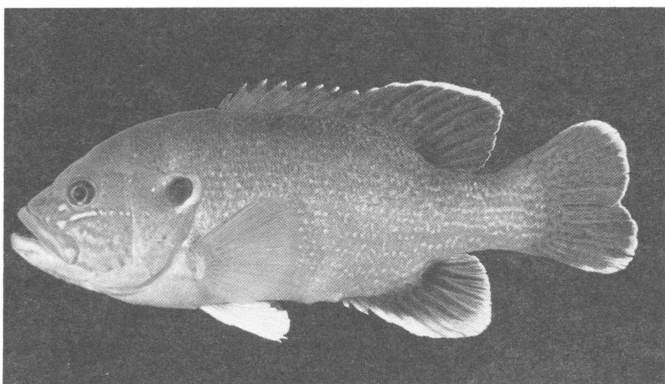
Animals of the Prairie Faunal Region



Channel catfish



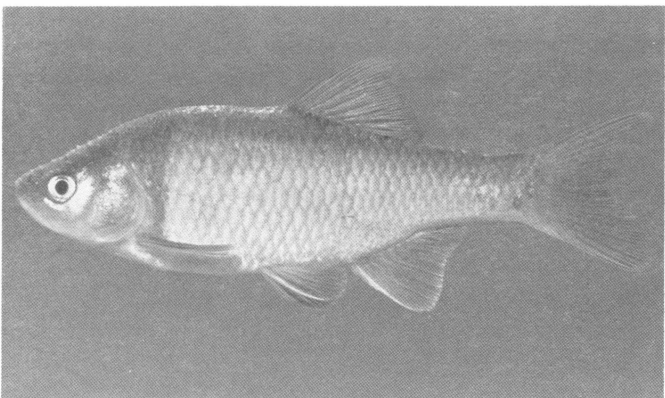
Johnny darter



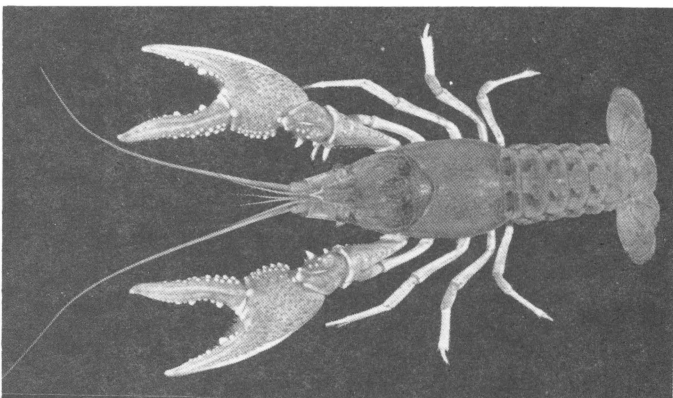
Green sunfish



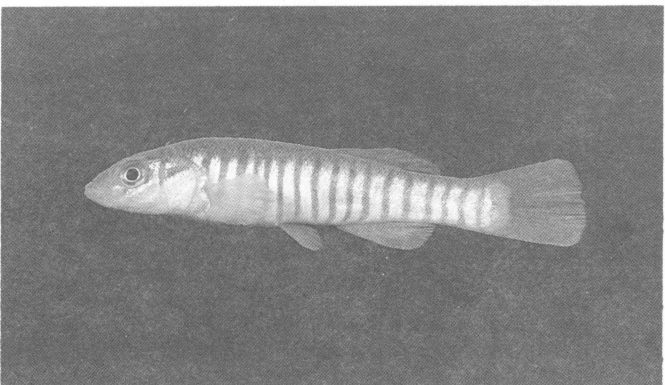
Northern crayfish frog



Red shiner



Northern crayfish



Plains killifish

Four species of amphibians and reptiles (Great Plains narrowmouth toad, northern crawfish frog, northern leopard frog, Illinois mud turtle, and Blanding's turtle) are restricted to the Prairie Region but are localized in occurrence. Common, more widespread species include smallmouth salamander, eastern tiger salamander, eastern American toad, Blanchard's cricket frog, western chorus frog, common snapping turtle, western painted turtle, red-eared slider, midland smooth softshell, blotched water snake, diamond-back watersnake, northern water snake, and Graham's crayfish snake.

The northern crayfish is the common stream crayfish in this region. The papershell crayfish and grassland crayfish are largely restricted to the Prairie Region. The warty-back mussel is restricted to this region. Common, widespread mussels include the giant floater, white heel splitter, pistol grip, maple leaf, pimple-back, warty-back, three-ridge, fragile papershell, pink paper-shell, pink heel-splitter, fat mucket and pocketbook.

Longitudinal Zonation

In Prairie streams, as in Ozark streams, there are regular and more or less predictable changes in physical factors and faunal composition as one progresses from the headwaters to the stream mouth. To facilitate comparisons with Ozark streams I have recognized four fish community zones in Prairie streams and defined their boundaries using the same criteria as for Ozark streams. In the following section I will present a general discussion of longitudinal zonation in Prairie streams, and make some comparisons with Ozark streams.

Headwater Zone

Distribution:

This zone includes stream reaches upstream from miles-to-headwater 6 that are order I, II, or III. Stream reaches that are order IV or V are placed in the Creek Zone, even if they fit the miles-to-headwater criterion for Headwaters.

Physical Features:

Prairie Headwaters typically arise on level to gently rolling upland prairies and occupy wide, shallow valleys. Their gradients are usually steeper than larger Prairie streams, but are less than Ozark Headwaters. At 179 Prairie Headwater localities, the local relief averaged 103 feet and the stream gradient averaged 26.0 feet/mile. Prairie Headwaters typically consist of short pools and well-defined riffles, but occasionally much longer and larger pools are present. The substrate frequently consists of gravel and rubble, but large quantities of silt and sand are often present. Prairie headwaters are subject to wide fluctuations in flow, and usually have ceased to flow by late summer. However, the larger pools generally contain water except in the severest droughts.

Biota:

The fish fauna of Prairie Headwaters is more limited than that of larger Prairie streams, and somewhat more limited than that of Ozark Headwaters. In my samples from Prairie Headwaters, the number of species per sample averaged 8.7, and the Margalef Diversity Index averaged

1.05. The most abundant large fish in Prairie Headwaters is usually the green sunfish, but the black bullhead, white sucker, orangespotted sunfish, bluegill, and largemouth bass are often common. Typical nektonic species, in order of abundance, include the fathead minnow, creek chub, redbfin shiner, central stoneroller, and bigmouth shiner. The orange-throat darter is the only benthic species that is at all common, and it is absent from some drainages.

Aquatic plants are generally absent from Prairie Headwaters.

Creek Zone

Distribution:

This zone includes reaches of miles-to-headwater 7-31 and order V or less, and also streams of less than miles-to-headwater 7 if they are of order IV or V.

Physical Features:

At 331 localities in Prairie Creeks the local relief averaged 129 feet, and the stream gradient averaged 8.5 feet/mile. In unchannelized Prairie Creeks the pools are often long and deep and the riffles are typically short and well defined. The substrate typically consists of sand (pools) and gravel or small rubble (riffles), with considerable silt in the quieter sections of pools and backwaters. The channel is usually bordered by vertical alluvial banks several feet in height. Flow is low or non-existent during dry periods of late summer, but the pools are generally permanent.

Biota:

Fish species richness and diversity increase as stream size increases in Prairie streams, as in Ozark streams. However, the increases are less rapid in Prairie streams. In my samples from Prairie Creeks, the number of species per sample averaged 14.3, and the Margalef Diversity Index averaged 1.62. The six species of large fishes listed for Prairie Headwaters are generally common in Prairie Creeks, and are often joined by the river carpsucker, channel catfish, golden redbhorse, and carp. Common nektonic species, in order of abundance in our samples, include the red shiner, redbfin shiner, bluntnose minnow, bigmouth shiner and central stoneroller. The orangethroat darter is joined by the johnny darter, suckermouth minnow, and logperch.

Water willow is common wherever rocky or stable gravelly substrates are present.

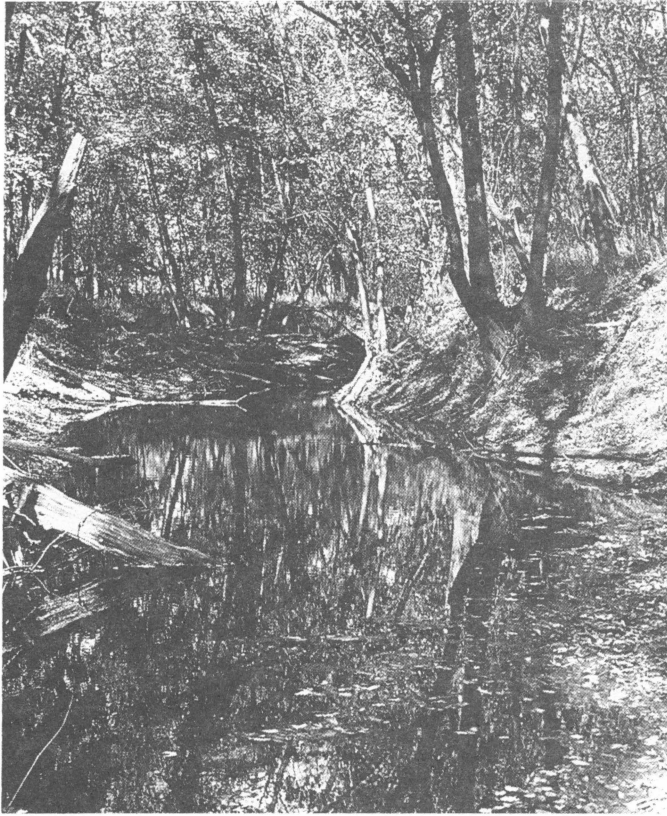
Small River Zone

Distribution:

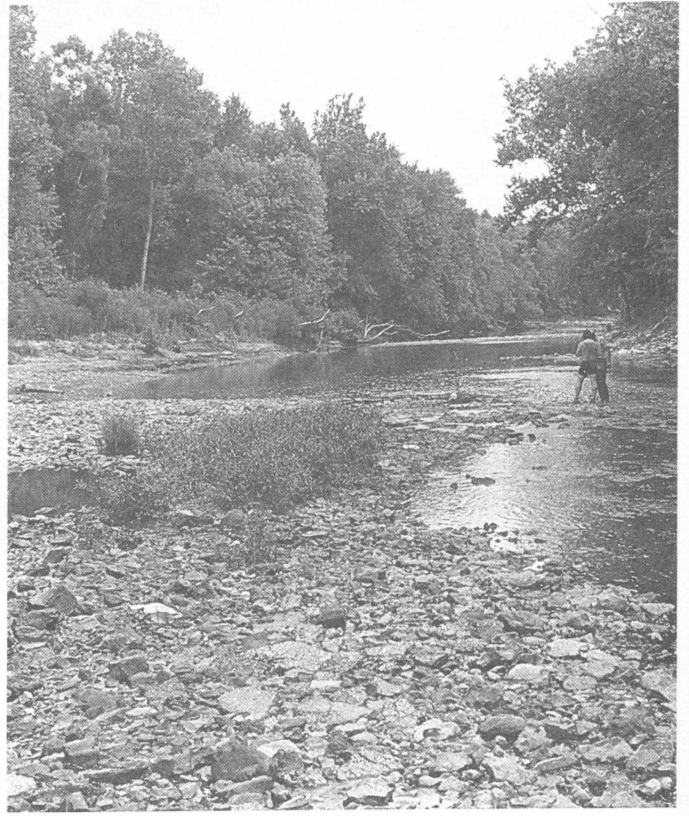
This zone includes all stream reaches of miles-to-headwater 32-96 and stream order VI or less, and also reaches of less than miles-to-headwater 32 if their order is VI.

Physical Features:

At 149 localities in Prairie Small Rivers the local relief averaged 146 feet, and the stream gradient averaged 3.1 feet/mile. Stream pools are very long, and riffles are sometimes poorly defined or absent. Small River reaches generally maintain some flow except in the most severe droughts.



South Fork, Salt River, Audrain County (Mississippi/Creek)



North Fork, Salt River, Monroe County (Mississippi/Large River)



West Fork, Cuivre River, Lincoln County (Mississippi/Small River)



Big Branch, Boone County (Lower Missouri/Headwater)

IV. B. Prairie-Lower Missouri

Distribution:

This division includes Prairie streams that are direct tributaries of the lower Missouri River, upstream to and including Perche Creek drainage north of the river and the Lamine-Blackwater drainage south of the river. Prairie sections of the Osage are not included.

Physical Features:

This division is along the southeastern margin of the Dissected Till Plains, but also includes unglaciated sections of the Lamine-Blackwater and adjacent drainages south of the Missouri River. Most of the streams originate on level uplands underlain by shales and descend into rolling to hilly terrain underlain by limestones. Streams south of the Missouri River from the Lamine River eastward are in limestones and dolomites throughout most of their lengths. Some tributaries of the Lamine River are very clear and Ozarkian in aspect. Generally speaking, there is a transition from north to south and from west to east in stream conditions, with streams to the north and west being less clear and with a greater proportion of sand and silt substrates. Those to the south and east tend to be clearer and often have extensive exposures of bedrock in their channels.

Biota:

Except for a few Ozark species with a limited distribution, all of the species that occur in this division also occur in other Prairie divisions. The common shiner and Topeka shiner are more abundant and generally distributed

in this division than anywhere else in Missouri. This division differs notably from the Prairie-Mississippi and Prairie-Upper Missouri divisions in the scarcity of the bigmouth shiner. The rosyface shiner, an abundant Ozark species, is more common in the Lower Missouri Division than in any other Prairie division. In the Prairie Region, the blacknose shiner is restricted to this division and the Osage Division.

Several common Ozark species occur in the Lower Missouri and Mississippi divisions but are absent from other Prairie divisions. These include the largescale stoneroller, southern redbelly dace, northern hog sucker, black redhorse, northern studfish, and smallmouth bass. The Prairie distribution of the blackside darter in Missouri is centered in these two divisions, with a few populations in eastern streams of the Upper Missouri Division. The Missouri distribution of the trout-perch is centered in the Lower Missouri and Upper Missouri divisions. The plains topminnow and least darter occur outside the Ozark Region only in the Prairie-Lower Missouri Division.

Longitudinal zonation of the fish communities differs from the general pattern in Prairie streams only by the greater prevalence of the Topeka shiner and common shiner in the Headwater Zone, the common shiner and rosyface shiner in the Creek Zone, and the common shiner, rosyface shiner, and blackside darter in the Small River Zone. No stream reaches of the Large River Zone are represented in this division. Water willow is abundant in streams of the Prairie-Lower Missouri Division.

Community Examples:

Headwater: South Fork Turkey Creek, Boone County; Splice Creek, Moniteau County; Otter Creek, Cooper County.

Creek: Whetstone Creek, Montgomery County; Silver Fork Creek, Boone County; Heaths Creek, Pettis County.

Small River: Auxvasse Creek, Callaway County; Perche Creek, Boone County; Lamine River, Cooper County.

Large River: None present.

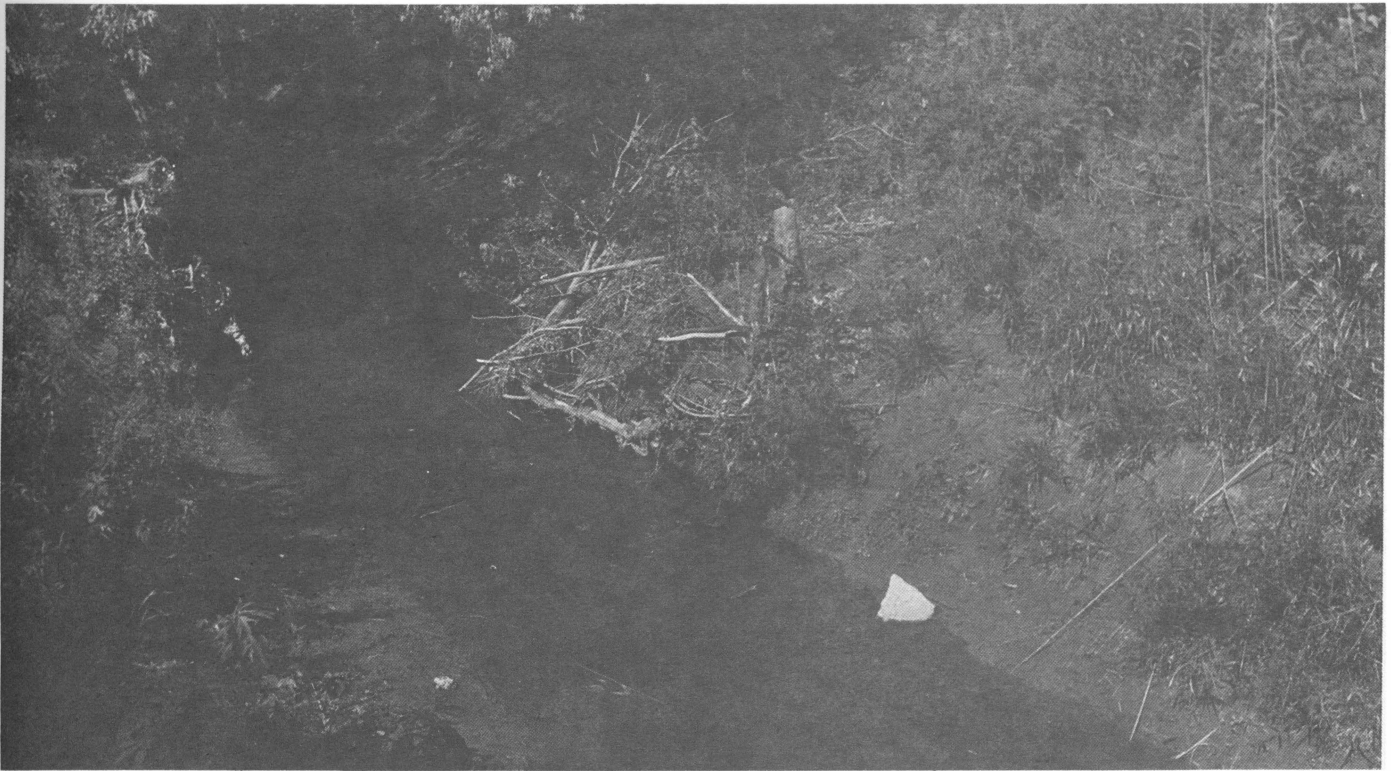




Haw Creek, Morgan County (Lower Missouri/Creek)



Perche Creek, Boone County (Lower Missouri/Small River)



Bottis Creek, Chariton County (Upper Missouri/Headwater)

IV. C. Prairie-Upper Missouri

Distribution:

This division includes all streams of the Missouri River drainage from Moniteau Creek, Howard County westward, exclusive of the Blackwater-Lamine system.

Physical Features:

This division is entirely within the Dissected Till Plains. The topography consists of broad, flat stream valleys and rolling to undulating (occasionally hilly) uplands.

The bedrocks are principally shales and sandstones, overlain by thick deposits of alluvium, glacial till, and loess. The streams are turbid, with silt-sand substrates and occasional rocky outcrops. Numerous oxbow lakes, sloughs, and marshes occur along the major streams.

Biota:

The fish communities are lowest in species richness and diversity of any of the five Prairie divisions. This results primarily from the absence or scarcity of species that are common and widespread in some other Prairie divisions. These include the golden redhorse, bluegill, long-ear sunfish, smallmouth bass, largemouth bass, golden shiner, ghost shiner, slender madtom, blackstripe topminnow, striped fantail darter, orangethroat darter, logperch, and slenderhead darter. Three kinds of fishes are restricted in Missouri to the Upper Missouri division, but are uncommon. These are the brassy minnow, plains killifish, and plains orangethroat darter (as intergrades with the northeastern orangethroat darter).

The common shiner, Topeka shiner, and trout-perch are largely restricted in Missouri to the Upper Missouri and Lower Missouri divisions. The bigmouth shiner is largely

restricted to the Upper Missouri and Mississippi divisions. Big River fishes that are more prevalent in the Upper Missouri division than in other Prairie divisions include the goldeye, western silvery minnow, plains minnow, speckled chub, flathead chub, and silver chub.

Longitudinal zonation differs from the pattern exhibited by most Prairie streams in the abundance of the bigmouth shiner in the Headwater and Creek zones, the western silvery minnow and plains minnow in the Small River Zone, and the western silvery minnow, plains minnow, and



speckled chub in the Large River Zone. The absence of darters and golden redhorse in the Small River and Large River zones is another notable feature.

Freshwater mussels have been nearly eliminated from the division, probably by heavy sedimentation and channelization of the streams.

Water willow and other aquatic plants are scarce or absent along the channels of most streams in the Upper Missouri Division.

Community Examples:

Headwater: McElroy Creek, Atchison County; Tombstone Creek, Harrison County; Salt Creek, Howard County.

Creek: Marrowbone Creek, Daviess County; Shoal Creek, Putnam County; Fishing River, Clay County.

Small River: Crooked River, Ray County; Mussel Fork, Chariton County; Locust Creek, Linn County.

Large River: Platte River, Platte County; Grand River, Carroll County; Chariton River, Chariton County.



Clear Creek, Clay County (Upper Missouri/Creek)



Mussel Fork, Chariton County (Upper Missouri/Small River)



Baker Ranch, St. Clair County (Osage/Headwater)

IV. D. Prairie-Osage

Distribution:

This division includes all streams of the Osage River drainage within the Prairie Region.

Physical Features:

The Prairie-Osage Division encompasses most of the Osage Plains Physiographic section of Missouri. It is underlain by alternating beds of shales, sandstones and limestones. The streams occupy broad, shallow valleys that slope gradually into the flat to gently rolling uplands. The streams are intermittent and turbid. The pools are long and the riffles are poorly defined. Substrates consist mostly of sand and silt in the pools, and slate-like pieces of shale and sandstone in the riffles. Oxbow lakes, sloughs and marshes abound along the major streams.

Biota:

The fish fauna of the Prairie-Osage Division is rather limited in diversity, and is composed principally of species that are widely distributed in Prairie streams. Its most notable feature is the scarcity of certain widespread Prairie species. These include the shortnose gar, goldeye, quillback, golden redhorse, shorthead redhorse, bigmouth shiner, Johnny darter, and blackside darter. The warmouth, greenside darter, and slough darter are scarce here, but still are more prevalent than in other Prairie divisions. The hornyhead chub and blacknose shiner are more prevalent in the Prairie-Osage and Prairie-Lower Missouri than in other Prairie divisions. The freckled madtom is most prevalent here and in the Prairie-Mississippi Division.

Longitudinal zonation in this division differs notably from the general pattern in Prairie streams in the scarcity of the white sucker and prevalence of the slough darter in Headwaters, the scarcity of the Johnny darter in the Creek Zone, and the prevalence of the brook silverside in the Small River Zone.

Aquatic plants are uncommon in streams of this division.

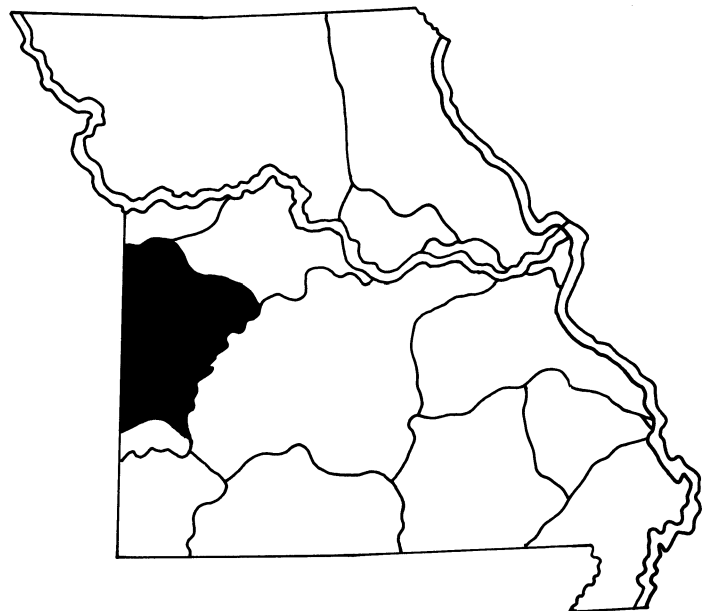
Community Examples:

Headwater: Baker Branch, St. Clair County; First Nicholson Creek, Barton County; Harding Creek, Cass County.

Creek: Little Clear Creek, St. Clair County; Mormon Fork, Bates County; Miami Creek, Bates County.

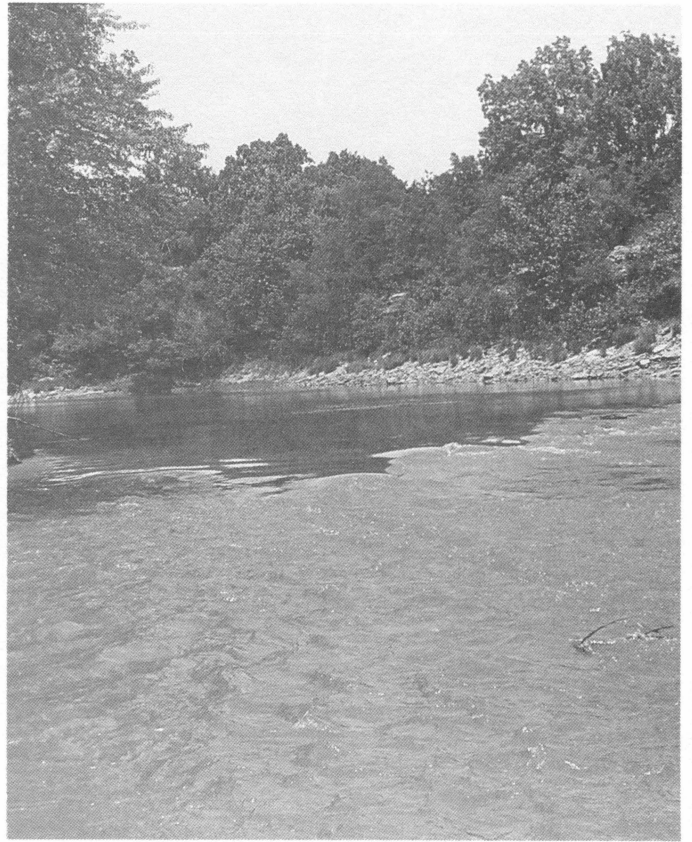
Small River: Little Drywood Creek, Vernon County; Little Osage River, Vernon County; Deepwater Creek, Henry County.

Large River: Marmaton River, Vernon County; Osage River, Bates County; South Grand River, Henry County.





Little Drywood Creek, Vernon County (Osage/Creek)



Osage River, Bates County (Osage/Large River)



Little Osage River, Vernon County (Osage/Small River)



Unnamed Creek, Jasper County (Neosho/Headwater)

IV. E. Prairie-Neosho

Distribution:

This is the smallest of the Prairie divisions, including only the Little North Fork and North Fork of Spring River drainages, exclusive of Buck Branch and Lower Dry Fork.

Physical Features:

This division spans the border between the Osage Plains and Springfield Plateau, including a portion of both physiographic regions. It is underlain by beds of shale, sandstone, and limestone. The streams occupy broad, shallow valleys, and the uplands are level to rolling. The stream channel consists of long pools and short, rocky and gravelly riffles. The streams are relatively clear for prairie streams.

Biota:

The typical fishes of the Prairie-Neosho Division are common widely distributed Prairie species. Most of the fishes that set this division apart from other Prairie divisions are shared with the adjacent Ozark-Neosho Division, and are less common. These include the bluntface shiner, spotfin shiner, western slim minnow, southwestern mimic shiner, Arkansas darter, Neosho orangethroat darter, redbfin darter and channel darter. Prevalence of the spotted sucker and brindled madtom set this division apart from other Prairie divisions. Many fishes that are widespread in other Prairie divisions are uncommon or absent from the Prairie-Neosho Division. These include the river carpsucker, quillback, white sucker, sand shiner, fathead minnow, and creek chub.

Aquatic plants are uncommon in streams of this division.

Community Examples:

Headwater: Glendale Fork, Barton County; Dry Fork, Jasper County; Coon Creek, Barton County.

Creek: West Fork, Barton County; Little North Fork, Barton County; North Fork, Barton County.

Small River: North Fork, Jasper County.

Large River: Not represented in this division.





North Fork, Spring River, Jasper County (Neosho/Small River)



Tumbling Creek Cave Spring, Boone County (Special Communities/Spring Branch (Freshwater))

IV. F. Special Communities

IV. F. 1. Spring Branches (Freshwater)

Distribution:

Springs are infrequent in the Prairie Region, and are confined primarily to the Mississippi and Lower Missouri divisions.

Physical Features:

Springs of the Prairie Region issue primarily from carbonate rocks Mississippian in age or older. These springs are small, and many cease to flow in late summer. Most have direct connections to sinkholes and other sources of

surface water, and are subject to rapid and wide fluctuations in flow.

Biota:

Fishes, when present, are usually characteristic of head-water streams of the area in which the spring occurs. The central stoneroller, creek chub, and orangethroat darter are the most prevalent species. Disjunct populations of southern redbelly dace, banded sculpin, and mottled sculpin occur in some Prairie Springs.

Amphipods and isopods are characteristic invertebrates. Common species are *Crangonyx forbesi*, *Gammarus pseudolimnaeus*, and *Asellus brevicauda*.

Water cress occurs in some Prairie spring branches, but many have no higher aquatic plants.

Community Examples:

Heidemann Spring, Lincoln County; Tumbling Cave Spring, Boone County; Whaley Spring, Marion County.



Blue Lick Spring, Saline County (Special Communities/Spring Branches (Mineral))

IV. F. 2. Spring Branches (Mineral)

Distribution:

Mineral springs are uncommon in Missouri and the most notable examples are in Saline and Howard counties. Other mineral springs are known from Marion, Pike, Pettis, St. Clair, and Clay counties.

Physical Features:

The minerals in the spring water were entrapped in the sedimentary rocks at the time of their formation, and leached out by water derived from local precipitation. Mineral springs generally have a small but permanent flow. High salt and hydrogen sulfide concentrations are important determinants of the biota.

Biota:

The plains killifish is a characteristic inhabitant of saline or alkaline waters, and the easternmost self-sustaining population occurs in Salt Creek below Booneslick Spring, Howard County. The biting midge *Culicoides variipennis astralis* is the most abundant invertebrate in this spring.

The shore bug *Pentacora signoretti* is a coastal species that occurs at a few mineral springs in Missouri. The only inland locations for seashore salt grass are a few mineral springs in Howard and Saline counties.

Community Examples:

Blue Lick Spring, Saline County; Boone's Lick Spring, Howard County.



Devil's Ice Box Cave, Boone County (Special Communities/Subterranean streams)

IV. F. 3. Subterranean Streams

Distribution:

Cave streams are uncommon in the Prairie Region, and are found primarily in the Mississippi and Lower Missouri divisions.

Physical Features:

Cave streams generally occur in areas of karst topography, along stream valleys that intersect the subterranean drainage net. Absence of light and constant temperature are characteristic features. Virtually all of the energy to support the biota is imported into the system by way of organic material that is washed in or is brought in by animals.

Biota:

Plants, other than certain bacteria that reduce sulphur and other inorganic compounds, are absent. Cave fishes are unknown from Prairie cave streams. Invertebrates consist mostly of kinds found in nearby freshwater springs. However a distinct species of flatworm, *Macrocotyla glandulosa*, is associated with the cave system at Rock Bridge State Park, Boone County.

Community Examples:

Devil's Icebox Cave and Hunter's Cave, Boone County.



Spile Lake, Vernon County (Special Communities/Overflow Waters)

IV. F. 4. Overflow Waters.

Distribution:

Overflow waters occur along streams of all sizes, but are most prevalent on the broad flood plains of the larger rivers.

Physical Features:

This habitat typically originates as an abandoned stream channel, and is proportional in size to the stream that formed it. Current is absent except during floods, and silt is the predominate substrate. Turbidity is usually high.

Biota:

The fish fauna is typically a subset of that in the adjacent stream, with species characteristic of quiet pools and backwaters predominating. Centrarchids (green sunfish,

orangespotted sunfish, bluegill, largemouth bass, and white crappie), along with gizzard shad, common carp, and black bullhead, generally comprise the bulk of the large-fish populations. Typical nektonic species are the golden shiner, mosquitofish, fathead minnow, and red shiner. The only self-sustaining population of the central mudminnow in Missouri occurs in a spring-fed marsh in Clark County. Benthic fish are rare.

The pond mussel is the most characteristic mussel. The papershell crayfish and white river crayfish are characteristic of this habitat. The grassland crayfish is especially common in seasonally flooded low-lying areas on Missouri's remaining native prairies.

Community Examples:

Goose Pond, Clark County.



Pickerelweed Pond, Lincoln County (Special Communities/Sinkhole Ponds)

IV. F. 5. Sinkhole Ponds

Distribution:

The largest concentrations of sinkholes in the Prairie Region are along the Mississippi River in Pike and Lincoln counties, and along the Missouri River in Boone and Cooper counties.

Physical Features:

These sinkholes are in carbonate rocks of Mississippian age or older. Most are relatively shallow, and are subject to drastic seasonal fluctuations in depth, or dry completely in late summer. Most have been altered by man's activities.

Biota:

No prairie sinkholes are known to support a native fish fauna, but the green sunfish, black bullhead, and other species have been introduced into some. Fishless sinkhole ponds are important breeding sites for several amphibians. These include the ringed salamander, marbled salamander, and eastern tiger salamander. Duckweeds, water shield, American lotus, and common cattail are typical plants. Pickerelweed Pond in Lincoln County supports a population of *Najas gracillima*, a plant of northern affinity that is rare in Missouri.

Community Examples:

Coats Pond, Boone County; Pickerelweed Pond, Lincoln County.

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APPENDIX I—Scientific and Common Names of Plants and Animals Mentioned in this Report.

Plants

<i>Taxodium distichum</i>	Bald Cypress
<i>Typha latifolia</i>	Common Cattail
<i>Potamogeton nodosus</i>	American Pondweed
<i>Potamogeton pulcher</i>	Spotted Pondweed
<i>Anarcharis nuttallii</i>	Elodea
<i>Valisneria americana</i>	Eelgrass
<i>Distichlis spicata</i>	Seashore Salt Grass
<i>Lemna minor</i>	Lesser Duckweed
<i>Heteranthera limosa</i>	Mud Plantain
<i>Saururus cernuus</i>	Lizard's Tail
<i>Ceratophyllum demersum</i>	Coontail
<i>Nuphar luteum</i>	Yellow Pond Lily
<i>Nelumbo lutea</i>	American Lotus
<i>Brasenia schreberi</i>	Water-Shield
<i>Nasturtium officinale</i>	Water Cress
<i>Callitriche heterophylla</i>	Water Starwort
<i>Hibiscus lasiocarpus</i>	Rose Mallow
<i>Jussiaea repens</i>	Water Primrose
<i>Myriophyllum heterophyllum</i>	Water Milfoil
<i>Nyssa aquatica</i>	Swamp Tupelo
<i>Veronica comosa</i>	Water Speedwell
<i>Utricularia gibba</i>	Bladderwort
<i>Justicia americana</i>	Water Willow
<i>Cephalanthus occidentalis</i>	Buttonbush

Freshwater Mussels

<i>Cumberlandia monodonta</i>	Spectacle Case
<i>Anodonta grandis grandis</i>	Giant Floater
<i>Anodontoides ferussacianus</i>	Cylindrical Paper Shell
<i>Strophitus undulatus undulatus</i>	Squaw Foot
<i>Alasmodonta viridis</i>	Slipper Shell
<i>Simpsonia ambigua</i>	Salamander Mussel
<i>Lampsilis complanata</i>	White Heel-splitter
<i>Lasmigona costata</i>	Fluted Shell
<i>Tritogonia verrucosa</i>	Pistolgrip
<i>Quadrula quadrula</i>	Maple Leaf
<i>Quadrula pustulosa</i>	Pimple-back
<i>Quadrula cylindrica cylindrica</i>	Rabbit's Foot
<i>Quadrula nodulata</i>	Warty-back
<i>Amblema plicata</i>	Three-ridge
<i>Fusconaia ozarkensis</i>	Ozark Shell
<i>Plethobasus cyphus</i>	Bullhead
<i>Elliptio crassidens crassidens</i>	Elephant's Ear
<i>Ptychobranhus occidentalis</i>	Kidney Shell
<i>Cyprogenia aberti</i>	Western Fan Shell
<i>Venustaconcha ellipsiformis ellipsiformis</i>	Ellipse
<i>Venustaconcha ellipsiformis pleasi</i>	Plea's Mussel
<i>Leptodea leptodon</i>	Scale Shell
<i>Leptodea fragilis</i>	Fragile Paper Shell
<i>Potamilus alatus</i>	Pink Heel-splitter
<i>Potamilus ohioensis</i>	Pink Paper Shell
<i>Toxolasma lividus glans</i>	Little Purple
<i>Legumia subrostrata</i>	Pond Mussel
<i>Villosa iris iris</i>	Rainbow Shell
<i>Villosa lienosa lienosa</i>	Little Spectacle Case

Lampsilis radiata luteola
Lampsilis orbiculata
Lampsilis rafinesqueana
Lampsilis ventricosa
Lampsilis reeviana
Epioblasma triquetra
Epioblasma florentina curtisi

Fat mucket
Pink Mucket
Neosho Mucket
Pocketbook
Reeve's mussel
Snuffbox
Curtis' Shell

Crayfish

<i>Cambarellus pueur</i>	Striped Dwarf Crayfish
<i>Cambarellus shufeldtii</i>	Speckled Dwarf Crayfish
<i>Cambarus hubbsi</i>	Hubb's Crayfish
<i>Cambarus hubrichti</i>	Salem Cave Crayfish
<i>Cambarus maculatus</i>	Freckled Crayfish
<i>Cambarus setosus</i>	Bristly Cave Crayfish
<i>Fallicambarus fodiens</i>	Eastern Digging Crayfish
<i>Faxonella clypeata</i>	Shield Crayfish
<i>Orconectes eupunctus</i>	Coldwater Crayfish
<i>Orconectes harrisoni</i>	Blackbanded Crayfish
<i>Orconectes hylas</i>	Woodland Crayfish
<i>Orconectes immunis</i>	Papershell Crayfish
<i>Orconectes lancifer</i>	Shrimp Crayfish
<i>Orconectes longidigitus</i>	Longpincer Crayfish
<i>Orconectes luteus</i>	Golden Crayfish
<i>Orconectes macrus</i>	Neosho Midget Crayfish
<i>Orconectes marchandi</i>	Mammoth Spring Crayfish
<i>Orconectes medius</i>	Saddleback Crayfish
<i>Orconectes meeki</i>	Meek's crayfish
<i>Orconectes neglectus chaenodactylus</i>	Gapefingered Crayfish
<i>Orconectes neglectus neglectus</i>	Ringed Crayfish
<i>Orconectes ozarkae</i>	Ozark Crayfish
<i>Orconectes palmeri</i>	Gray-speckled Crayfish
<i>Orconectes peruncus</i>	Big Creek Crayfish
<i>Orconectes punctimanus</i>	Spothanded Crayfish
<i>Orconectes quadruncus</i>	St. Francis River Crayfish
<i>Orconectes virilis</i>	Northern Crayfish
<i>Orconectes williamsi</i>	Excavator Crayfish
<i>Procambarus acutus</i>	White River Crayfish
<i>Procambarus clarkii</i>	Red Swamp Crayfish
<i>Procambarus gracilis</i>	Grassland Crayfish
<i>Procambarus viaeviridis</i>	Vernal Crayfish

Fishes

Large

Ichthyomyzon unicuspis
Ichthyomyzon castaneus
Acipenser fulvescens
Scaphirhynchus platyrhynchus
Scaphirhynchus albus
Polyodon spathula
Lepisosteus spatula
Lepisosteus platostomus
Lepisosteus oculatus
Lepisosteus osseus
Amia calva

Silver Lamprey
Chestnut Lamprey
Lake Sturgeon
Shovelnose Sturgeon
Pallid Sturgeon
Paddlefish
Alligator Gar
Shortnose Gar
Spotted Gar
Longnose Gar
Bowfin

Alosa chrysochloris
Alosa alabamiae
Dorosoma cepedianum
Dorosoma petenense
Hiodon alosoides
Oncorhynchus mykiss
Esox americanus
Aristichthys nobilis
Ctenopharyngodon idella
Cyprinus carpio
Hypophthalmichthys molitrix
Carpoides velifer
Carpoides carpio
Carpoides cyprinus
Catostomus commersoni
Cycleptus elongatus
Hypentelium nigricans
Ictiobus cyprinellus
Ictiobus niger
Minytrema melanops
Moxostoma anisurum
Moxostoma carinatum
Moxostoma duquesnei
Moxostoma erythrurum
Moxostoma macrolepidotum
Ictalurus furcatus
Ictalurus melas
Ictalurus natalis
Ictalurus nebulosus
Ictalurus punctatus
Pylodictis olivaris
Lota lota
Morone chrysops
Morone mississippiensis
Ambloplites rupestris
Ambloplites ariommus
Ambloplites constellatus
Lepomis cyanellus
Lepomis gulosus
Lepomis humilis
Lepomis macrochirus
Lepomis megalotis
Lepomis microlophus
Lepomis punctatus
Micropterus dolomieu
Micropterus punctulatus
Micropterus salmoides
Pomoxis annularis
Pomoxis nigromaculatus
Stizostedion canadense
Stizostedion vitreum
Aplodinotus grunniens
Mugil cephalus

Nektonic

Osmerus mordax
Umbra limi
Campostoma anomalum
Campostoma oligolepis
Ericymba buccata
Hybognathus argyritis
Hybognathus hankinsoni
Hybognathus hayi
Hybognathus nuchalis

Skipjack Herring
 Alabama Shad
 Gizzard Shad
 Threadfin Shad
 Goldeye
 Rainbow Trout
 Grass Pickerel
 Bighead carp
 Grass Carp
 Common Carp
 Silver carp
 Highfin Carpsucker
 River Carpsucker
 Quillback
 White Sucker
 Blue Sucker
 Northern Hog Sucker
 Bigmouth Buffalo
 Black Buffalo
 Spotted Sucker
 Silver Redhorse
 River Redhorse
 Black Redhorse
 Golden Redhorse
 Shorthead Redhorse
 Blue Catfish
 Black Bullhead
 Yellow Bullhead
 Brown Bullhead
 Channel Catfish
 Flathead Catfish
 Burbot
 White Bass
 Yellow Bass
 Rock Bass
 Shadow Bass
 Ozark Bass
 Green Sunfish
 Warmouth
 Orangespotted sunfish
 Bluegill
 Longear Sunfish
 Redear Sunfish
 Spotted Sunfish
 Smallmouth Bass
 Spotted Bass
 Largemouth Bass
 White Crappie
 Black Crappie
 Sauger
 Walleye
 Freshwater Drum
 Striped Mullet

Rainbow Smelt
 Central Mudminnow
 Central Stoneroller
 Largescale Stoneroller
 Silverjaw Minnow
 Western Silvery Minnow
 Brassy Minnow
 Cypress Minnow
 Mississippi Silvery Minnow

Hybognathus placitus
Hybopsis amblops
Hybopsis gracilis
Hybopsis storeriana
Nocomis asper
Nocomis biguttatus
Notemigonus crysoleucas
Notropis amnis
Notropis atherinoides
Notropis blennioides
Notropis boops
Notropis burchanani
Notropis camurus
Notropis cardinalis
Notropis chalybaeus
Notropis chrysocephalus
Notropis cornutus
Notropis dorsalis
Notropis emiliae
Notropis fumeus
Notropis galacturus
Notropis greenei
Notropis heterolepis
Notropis hudsonius
Notropis lutrensis
Notropis maculatus
Notropis nubilus
Notropis ozarcanus
Notropis pilsbryi
Notropis rubellus
Notropis telescopus
Notropis sabiniae
Notropis shumardi
Notropis spilopterus
Notropis stramineus
Notropis texanus
Notropis topeka
Notropis u. unbratilis
Notropis u. cyanocephalus
Notropis venustus
Notropis v. volucellus
Notropis v. wickliffi
Notropis v. ssp.
Notropis whipplei
Notropis zonatus
Phoxinus erythrogaster
Pimephales notatus
Pimephales promelas
Pimephales t. tenellus
Pimephales t. parviceps
Pimephales vigilax
Semotilus atromaculatus
Erimyzon oblongus
Amblyopsis rosae
Typhlichthys subterraneus
Chologaster agassizi
Aphredoderus sayanus
Percopsis omiscomaycus
Fundulus catenatus
Fundulus chrysotus
Fundulus zebrinus
Fundulus notti
Fundulus notatus
Fundulus olivaceus

Plains Minnow
 Bigeye Chub
 Flathead Chub
 Silver Chub
 Redspot Chub
 Hornyhead Chub
 Golden Shiner
 Pallid Shiner
 Emerald Shiner
 River Shiner
 Bigeye Shiner
 Ghost Shiner
 Bluntnose Shiner
 Cardinal shiner
 Ironcolor Shiner
 Striped Shiner
 Common Shiner
 Bigmouth Shiner
 Pugnose Minnow
 Ribbon Shiner
 Whitetail Shiner
 Wedgespot Shiner
 Blacknose Shiner
 Spottail Shiner
 Red Shiner
 Taillight Shiner
 Ozark Minnow
 Ozark Shiner
 Duskystripe Shiner
 Rosyface Shiner
 Telescope Shiner
 Sabine Shiner
 Silverband Shiner
 Spotfin Shiner
 Sand Shiner
 Weed Shiner
 Topeka Shiner
 Western Redfin Shiner
 Eastern Redfin Shiner
 Blacktail Shiner
 Northeastern Mimic Shiner
 Channel Mimic Shiner
 Southwestern Mimic Shiner
 Steelcolor Shiner
 Bleeding Shiner
 Southern Redbelly Dace
 Bluntnose Minnow
 Fathead Minnow
 Western Slim Minnow
 Eastern Slim Minnow
 Bullhead Minnow
 Creek Chub
 Creek Chubsucker
 Ozark Cavefish
 Southern Cavefish
 Spring Cavefish
 Pirate Perch
 Trout Perch
 Northern Studfish
 Golden Topminnow
 Plains Killifish
 Starhead Topminnow
 Blackstripe Topminnow
 Blackspotted Topminnow

Fundulus sciadicus
Gambusia affinis
Labidesthes sicculus
Menidia beryllina
Centrarchus macropterus
Elassoma zonatum

Benthic

Ichthyomyzon fossor
Ichthyomyzon gagei
Lampetra aepyptera
Lampetra appendix
Hybopsis aestivalis
Hybopsis dissimilis
Hybopsis gelida
Hybopsis meeki
Hybopsis x-punctata
Phenacobius mirabilis
Noturus albater
Noturus eleutherus
Noturus exilis
Noturus flavater
Noturus flavus
Noturus gyrinus
Noturus miurus
Noturus nocturnus
Noturus placidus
Ammocrypta asprella
Ammocrypta clara
Ammocrypta vivax
Etheostoma asprigene
Etheostoma blenniodes
Etheostoma caeruleum
Etheostoma chlorosomum
Etheostoma fusiforme
Etheostoma cragini
Etheostoma euzonum
Etheostoma e. euzonum
Etheostoma e. erizonum
Etheostoma f. flabellare
Etheostoma flabellare ssp.
Etheostoma gracile
Etheostoma histrio
Etheostoma juliae
Etheostoma microperca
Etheostoma nianguae
Etheostoma nigrum
Etheostoma parvipinne
Etheostoma proeliare
Etheostoma punctulatum
Etheostoma s. spectabile
Etheostoma s. squamosum
Etheostoma s. pulchellum
Etheostoma s. uniporum
Etheostoma spectabile ssp.
Etheostoma stigmaeum
Etheostoma tetrazonum
Etheostoma whipplei
Etheostoma zonale
Percina c. caprodes
Percina c. fulvitaenia
Percina c. semifasciata
Percina copelandi

Plains Topminnow
 Mosquitofish
 Brook Silverside
 Inland Silverside
 Flier
 Banded Pygmy Sunfish

Northern Brook Lamprey
 Southern Brook Lamprey
 Least Brook Lamprey
 American Brook Lamprey
 Speckled Chub
 Streamline Chub
 Sturgeon Chub
 Sicklefing Chub
 Gravel Chub
 Suckermouth Minnow
 Ozark Madtom
 Mountain Madtom
 Slender Madtom
 Checkered Madtom
 Stonecat
 Tadpole Madtom
 Brindled Madtom
 Freckled Madtom
 Neosho Madtom
 Crystal Darter
 Western Sand Darter
 Scaly Sand Darter
 Mud Darter
 Greenside Darter
 Rainbow Darter
 Bluntnose Darter
 Swamp Darter
 Arkansas Darter
 Arkansas Saddled Darter
 White River Saddled Darter
 Current River Saddled Darter
 Barred Fantail Darter
 Golden Fantail Darter
 Slough Darter
 Harlequin Darter
 Yoke Darter
 Least Darter
 Niangua Darter
 Johnny Darter
 Goldstripe Darter
 Cypress Darter
 Stippled Darter
 Northeastern Orangethroat
 Neosho Orangethroat
 Plains Orangethroat
 Current River Orangethroat
 White River Orangethroat
 Speckled Darter
 Missouri Saddled Darter
 Redfin Darter
 Banded Darter
 Ohio Logperch
 Ozark Logperch
 Northern Logperch
 Channel Darter

Percina cymatotaenia
Percina evides
Percina maculata
Percina nasuta
Percina ouachitae
Percina phoxocephala
Percina sciera
Percina shumardi
Percina uranidea
Cottus bairdi
Cottus caroliniae
Cottus hypselurus

Bluestripe Darter
 Gilt Darter
 Blackside Darter
 Longnose Darter
 Saddleback Darter
 Slenderhead Darter
 Dusky Darter
 River Darter
 Stargazing Darter
 Mottled Sculpin
 Banded Sculpin
 Ozark Sculpin

Amphibians

Cryptobranchus alleganiensis alleganiensis
Cryptobranchus alleganiensis bishopi
Siren intermedia nettingi
Ambystoma annulatum
Ambystoma maculatum
Ambystoma opacum
Ambystoma talpoideum
Ambystoma texanum
Ambystoma tigrinum tigrinum
Notophthalmus viridescens louisianensis
Amphiuma tridactylum
Eurycea longicauda longicauda
Eurycea longicauda melanopleura
Eurycea lucifuga
Eurycea multiplicata griseogaster
Eurycea tynnerensis
Hemidactylium scutatum
Plethodon dorsalis angusticlavius
Plethodon glutinosus glutinosus
Plethodon serratus
Typhlotriton spelaeus
Scaphiopus bombifrons
Bufo americanus americanus
Bufo cognatus
Acris crepitans blanchardi
Hyla chrysoscelis
Hyla cinerea
Hyla crucifer crucifer
Hyla versicolor
Pseudacris streckeri illinoensis
Pseudacris triseriata feriarum
Pseudacris triseriata triseriata
Gastrophryne olivacea
Rana aerolata circulosa
Rana catesbeiana
Rana clamitans clamitans
Rana clamitans melanota
Rana palustris
Rana pipiens
Rana sphenoccephala
Rana sylvatica

Eastern Hellbender
 Ozark Hellbender
 Western Lesser Siren
 Ringed Salamander
 Spotted Salamander
 Marbled Salamander
 Mole Salamander
 Smallmouth Salamander
 Eastern Tiger Salamander
 Central Newt
 Three-toed Amphiuma
 Longtail Salamander
 Dark-sided Salamander
 Cave Salamander
 Graybelly Salamander
 Oklahoma Salamander
 Four-toed Salamander
 Ozark Zigzag Salamander
 Slimy Salamander
 Southern Redback Salamander
 Grotto Salamander
 Plains Spadefoot
 Eastern American Toad
 Great Plains Toad
 Blanchard's Cricket Frog
 Cope's Gray Treefrog
 Green Treefrog
 Northern Spring Peeper
 Eastern Gray Treefrog
 Illinois Chorus Frog
 Upland Chorus Frog
 Western Chorus Frog
 Great Plains Narrowmouth Toad
 Northern Crawfish Frog
 Bullfrog
 Bronze Frog
 Green Frog
 Pickerel Frog
 Northern Leopard Frog
 Southern Leopard Frog
 Wood Frog

Reptiles

<i>Chelydra serpentina serpentina</i>	Common Snapping Turtle	<i>Trionyx muticus muticus</i>	Midland Smooth Softshell
<i>Macrolemys temminckii</i>	Alligator Snapping Turtle	<i>Trionyx spiniferus hartwegi</i>	Western Spiny Softshell
<i>Kinosternon flavescens flavescens</i>	Yellow Mud Turtle	<i>Trionyx spinifer spinifer</i>	Eastern Spiny Softshell
<i>Kinosternon flavescens spooneri</i>	Illinois Mud Turtle	<i>Farancia abgacura reinwardtii</i>	Western Mud Snake
<i>Kinosternon subrubrum hippocrepis</i>	Mississippi Mud Turtle	<i>Nerodia cyclopion cyclopion</i>	Green Mud Snake
<i>Sternotherus odoratus</i>	Stinkpot	<i>Nerodia erythrogaster flavigaster</i>	Yellowbelly Water Snake
<i>Chrysemys picta bellii</i>	Western Painted Turtle	<i>Nerodia erythrogaster transversa</i>	Blotched Water Snake
<i>Chrysemys picta dorsalis</i>	Southern Painted Turtle	<i>Nerodia fasciata confluens</i>	Broad-banded Water Snake
<i>Deirochelys reticularia miaria</i>	Western Chicken Turtle	<i>Nerodia rhombifer rhombifer</i>	Diamondback Water Snake
<i>Emydoidea blandingii</i>	Blanding's Turtle	<i>Nerodia sipedon sipedon</i>	Northern Water Snake
<i>Graptemys kohnii</i>	Mississippi Map Turtle	<i>Regina grahamii</i>	Graham's Crayfish Snake
<i>Pseudemys concinna metteri</i>	Missouri River Cooter	<i>Agkistrodon piscivorus leucostoma</i>	Western Cottonmouth
<i>Trachemys scripta elegans</i>	Red-eared Slider		

APPENDIX II—Definitions of Technical Terms

Alluvium—Material such as silt or sand, transported and deposited by flowing water.

Alluvial plain—A nearly level region in which the topographic features were formed through the action of flowing water.

Backwater—A quiet inlet along the margin of a stream and connected with it at normal water levels.

Base flow—The flow of a stream during periods when there is no surface runoff.

Bedrock—Solid rock that underlies the surface material covering much of the earth's surface.

Benthic fishes—The smaller species of fish (generally not exceeding a length of about six inches) that spend much of the time on or in the substrate. Madtom catfish and darters are examples.

Biota—The particular combination of plants and animals occupying an area.

Blue hole—A body of relatively deep and steep-sided standing water, formed by the scouring action of a large river in flood.

Bluff—A nearly vertical exposure of bedrock or other solid material, usually bordering a stream or its valley.

Borrow pit—An artificial body of standing water formed by the removal of material for placement elsewhere.

Bottom type—See substrate.

Braided channel—Section of a stream composed of several interconnecting channels.

Carbonate rocks—Rocks such as limestone or dolomite containing large quantities of calcium carbonate (CaCO_3).

Chert—Coarse, angular fragments of silica rock or flint.

Chute—A river section having strong current and enough depth that the surface is not broken by rocks or other obstructions.

Community—A recurring association of animals and/or plants that occupies a particular habitat.

Dispersal—The process by which a species moves to and becomes established in a previously unoccupied area.

Dissected—A topography consisting of many closely approximated ridges and hills, formed primarily through the action of flowing water.

Dolomite—A type of sedimentary rock closely related to limestone but containing a greater proportion of magnesium.

Drainage divide—The boundary between one stream drainage and another.

Drainage system—See stream system.

Drought—An extended period without significant precipitation.

Elevation—Height above mean sea-level, measured in feet.

Emergent vegetation—Aquatic vegetation that extends above the water's surface.

Endemic—An animal or plant restricted to a specified area.

Extirpation—The disappearance of a species from an area where it formerly occurred.

Fauna—The particular combination of animals found in an area.

Flood plain—A relatively level strip of land adjacent to a stream and subject to inundation when the stream tops its banks.

Flowing waters—Streams and other waters with a unidirectional flow or current.

Gradient—The slope of a stream, measured in feet of drop per mile.

Habitat—The particular combination of physical conditions that characterize the place where a species or community is typically found. For aquatic organisms these conditions include such things as water depth and temperature, amount of current, substrate type, amount and type of aquatic vegetation, etc.

Igneous rock—Rock solidified from liquid material formed by heat and pressure deep within the earth. Granite and felsite are examples.

Intergrade—An individual that is structurally and genetically intermediate between two subspecies.

Intermittent—A term applied to a stream that has no surface flow for part of the year.

Large fishes—Fishes in which the adults typically exceed a total length of about six inches.

Limestone—A sedimentary rock composed largely of calcium carbonate (CaCO_3).

Loess—Deposits of finely divided material such as silt, transported to its location by wind.

Longitudinal succession (zonation)—The regular and more or less predictable changes in the species composition of aquatic communities along the length of a stream.

Margalef Diversity Index—One of several diversity indices, based on the number of species and their relative abundance in a sample.

Marsh—A body of shallow, standing water dominated by nonwoody plants such as cattails.

Miles-to-headwater—The distance along the stream channel from any given point upstream to the drainage divide of the longest headwater tributary.

Mississippian—One of several geologic time periods represented by bedrock formations in Missouri.

Nektonic fishes—The smaller species of fish (not ordinarily exceeding a length of six inches) that spend much of the time in midwater.

Order—See stream order.

Organic debris—A substrate type composed of plant fragments.

Overflow waters—A general term applied to standing waters that are subject to frequent flooding but not directly connected to a stream at ordinary low-water levels.

Oxbow lake—An isolated body of standing water formed when a stream abandons a loop in its channel.

Pennsylvanian—One of several geologic time periods represented by bedrock formations in Missouri.

Physiographic region—An area characterized by a particular combination of physical features such as bedrocks and topography.

Pool—A section of stream that is relatively deep and slow flowing, so the current is slow or absent and the surface is not noticeably broken by rocks and other obstructions.

Pre-Cambrian—The oldest of several geologic time periods represented by bedrocks in Missouri.

Relief—The difference in elevation between a stream bed and adjacent more elevated topographic features such as hills and ridges.

Reservoir—An artificial body of water created by the placement of a dam across a stream valley.

Revetment—A structure constructed of rock or other materials for protecting a streambank from erosion.

Riffle—A section of a stream with a noticeable current and shallow enough that the surface is conspicuously broken by rocks and other obstructions.

Sedimentary rock—Rock formed from materials transported and deposited by water. Shale, sandstone, and limestone are examples.

Shale—A sedimentary rock formed from clay.

Sinkhole pond—A body of standing water occurring in a natural depression formed by subsidence into a subterranean space.

Species richness—The number of species occurring in a given area or sample.

Slough—A body of shallow, standing water, characterized by a soft muck bottom and wide seasonal fluctuations in area and depth.

Standing waters—Waters without a noticeable current or flow. Lakes and sloughs are typical examples.

Stream cut-off—See oxbow lake.

Stream order—A number derived by counting the number of branches or forks in a stream and its tributaries, to give a general indication of stream size. An unbranched stream is Order 1. Downstream from the point where two Order 1 streams join, the stream becomes Order 2, and the order increases by 1 each time two streams of a given order join. Topographic maps of the largest scale available (7½' or 15') are used to determine stream order.

Stream system—An interconnected group of streams that form an integrated drainage.

Submergent vegetation—Vegetation that is entirely beneath the water's surface.

Substrate—The material comprising the bottom of a body of water. Silt, gravel, and bedrock are examples.

Subterranean—Beneath the surface of the earth.

Swamp—A body of shallow standing water dominated by woody plants.

Topography—The shape or physical features of the land's surface.

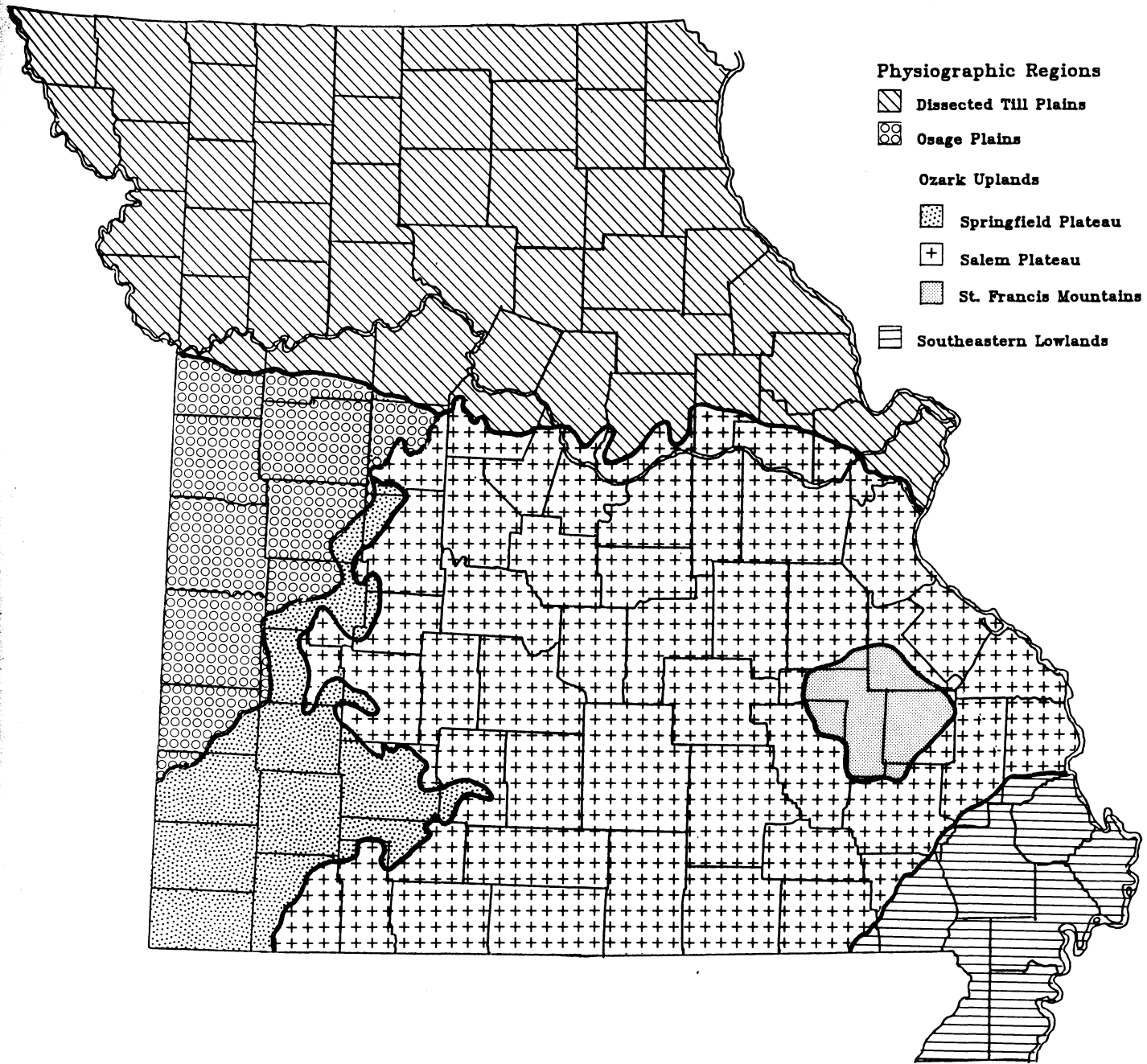
Topographic map—A map depicting topography with lines connecting points at the same elevation. Other natural and cultural features are also shown.

Tributary—A stream with a direct connection to another stream and contributing water to it.

Turbidity—The cloudiness of water resulting from the presence of suspended material.

Upland—The higher portions of a region.

Wing dike—A structure constructed of rock or other materials, extending at a downstream angle from the streambank, designed to deflect the current or flow.



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